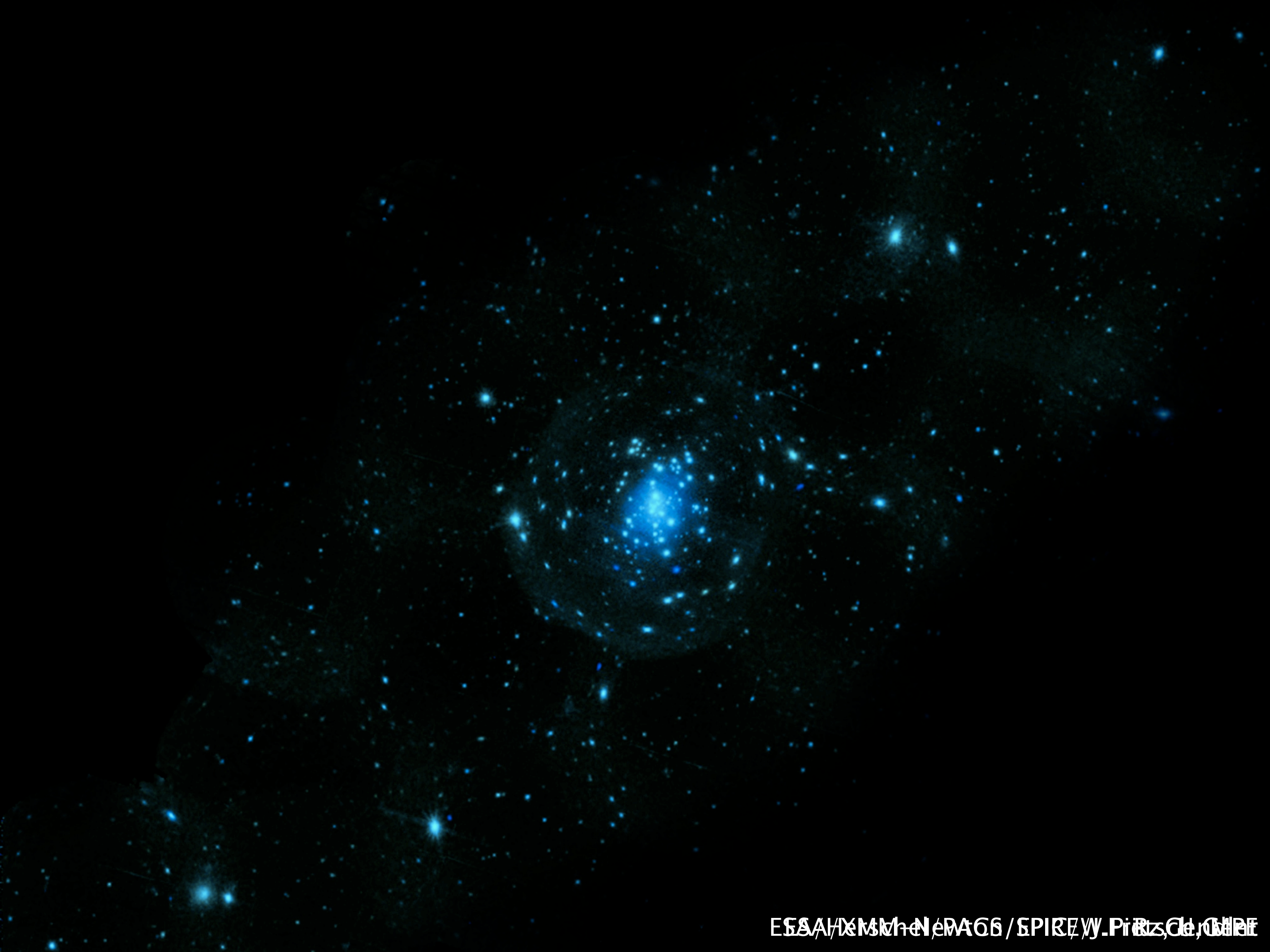
H A S H T A G

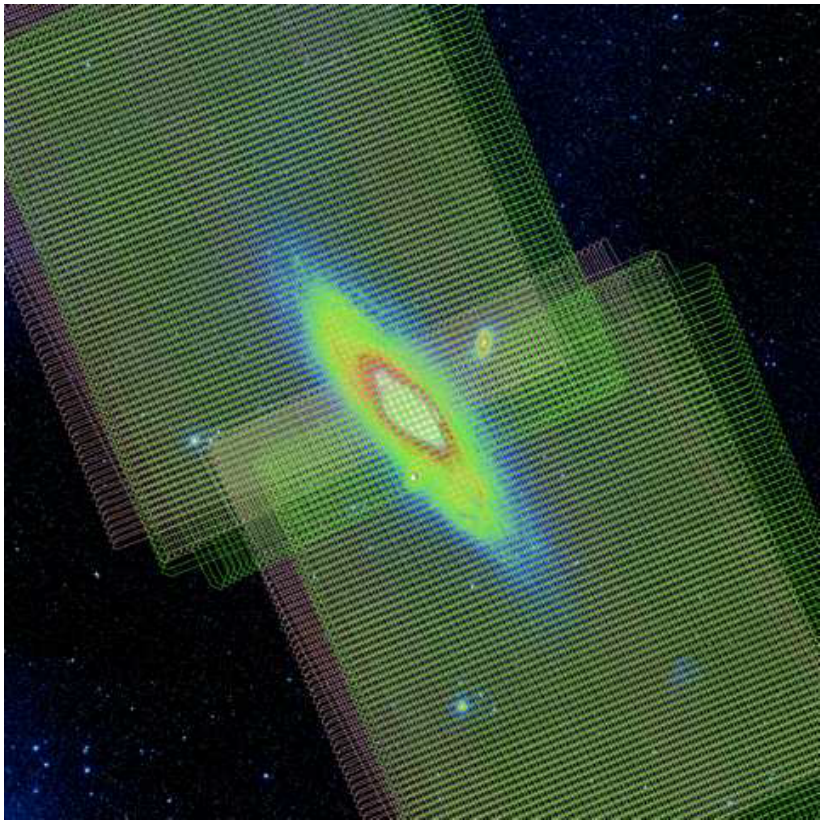
Overview + Progress

#ASHTAG

JCMT Andromeda Galaxy Survey


ESA/Herschel/PACS/SPIRE/J. Fritz, U. Gent
ESA/XMM-Newton/EPIC/W. Pietsch, MPE

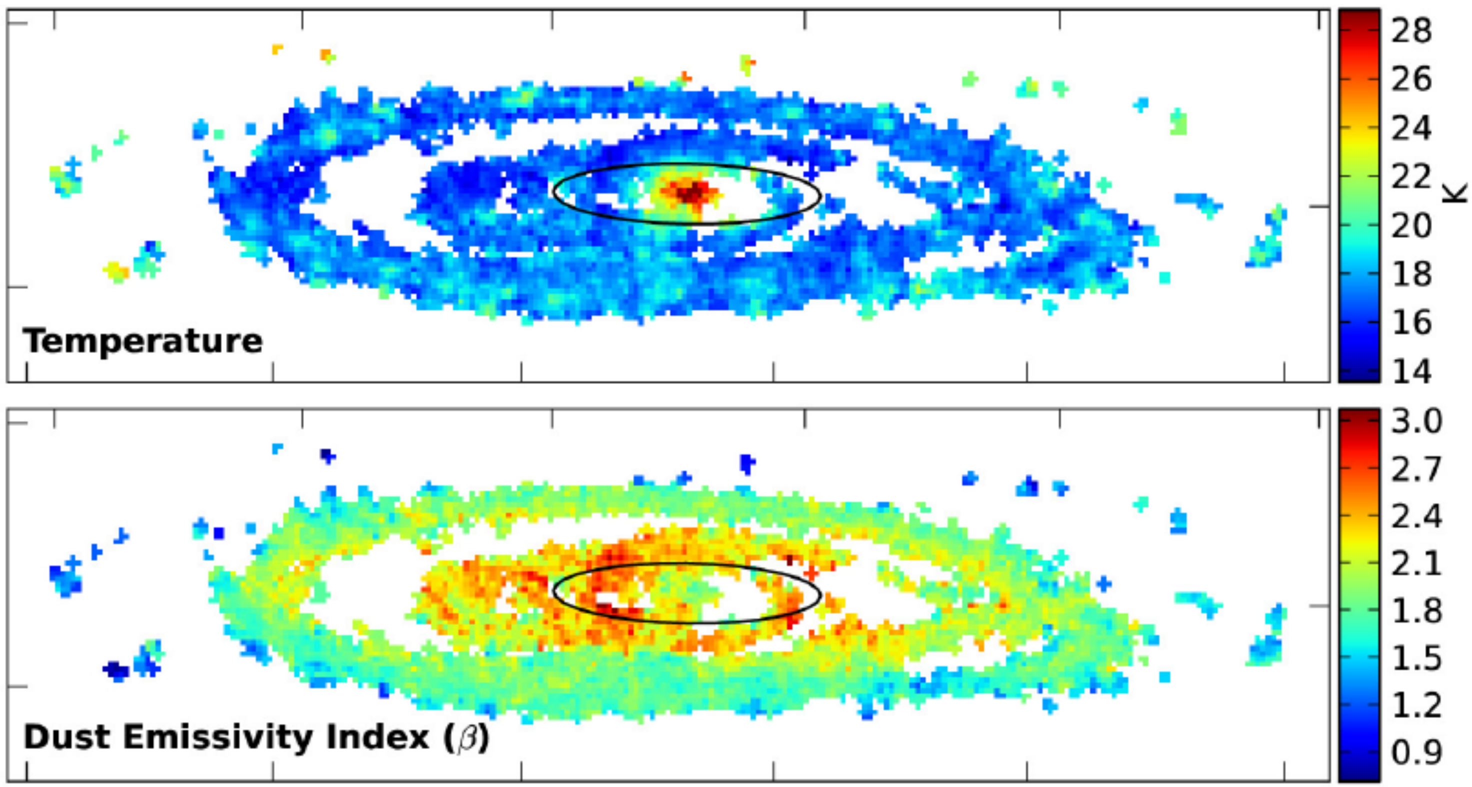
Herschel Exploitation of Local Galaxy Andromeda (HELGA)



- SPIRE/PACS guaranteed time programme.
- Parallel Mode Observations at 100, 160, 250, 350 and 500μm simultaneously.
- Observed whole HI disk ($5.5^\circ \times 2.5^\circ$)
- Krauss et al. also surveyed, they get 70μm as well.
- Complementary XMM
- Results shown on BBC TV

HELGA – Goals & Highlights

- Goal – Study characteristics of the dust and its relation to the interstellar gas and SF properties
- Science highlights (7 refereed papers published to date)
  - T & β distribution (Smith et al. 2012)
  - Radial variation of gas-to-dust ratio (Smith et al. 2012)



Harp And Scuba-2 Hi-resolution Terahertz Andromeda Galaxy survey (HASHTAG)

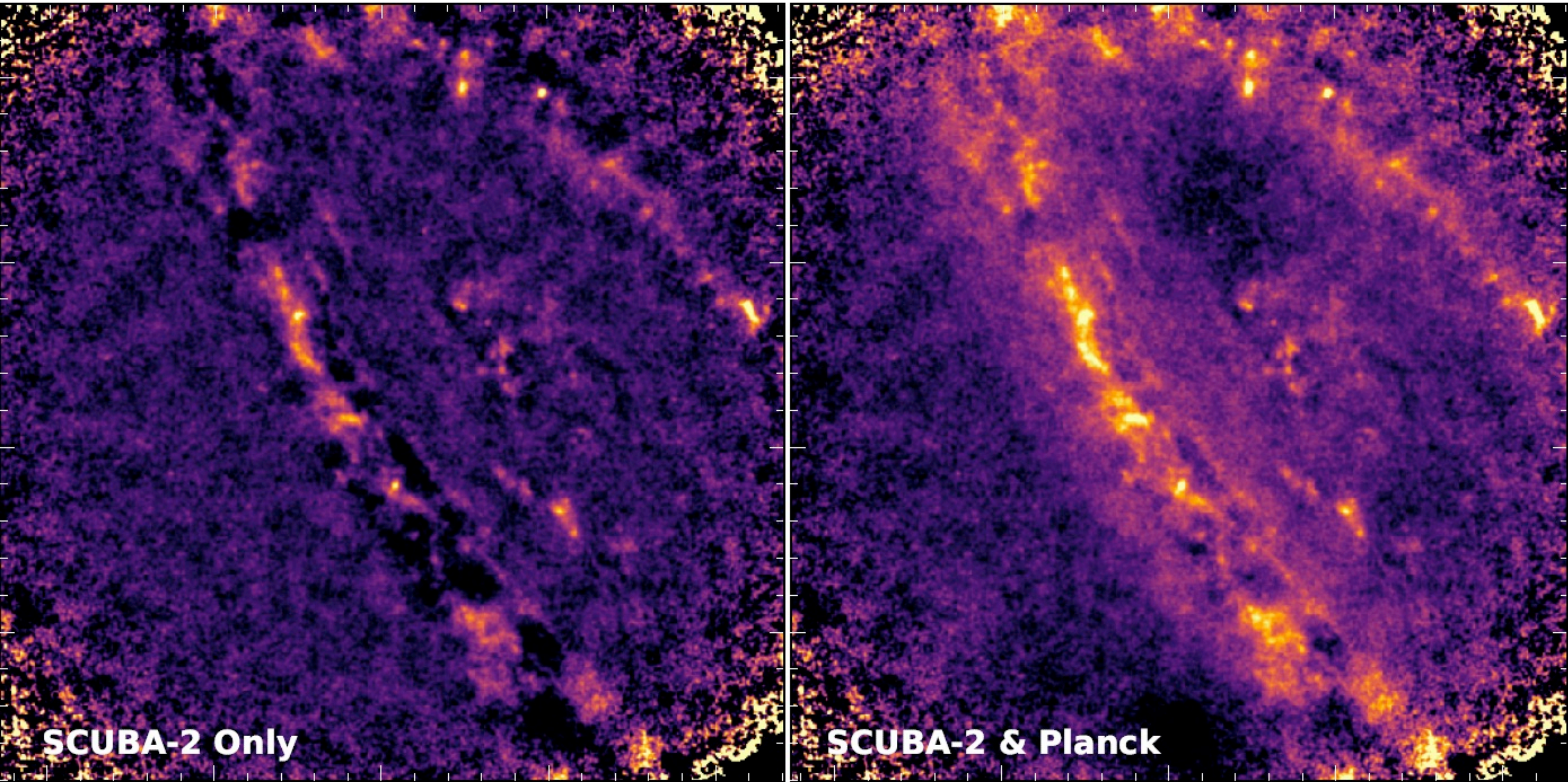
Continuing large survey tradition of convoluted acronyms

- A new JCMT large program – 275 hr
- Idea is to get deep SCUBA-2 images for the entirety of Andromeda
  - Entire FIR disk to 3 mJy/beam at 850μm
  - Entire FIR disk to 47 mJy/beam at 450μm
- CO(J=3–2) is a big contaminant, between 10–30%. Proposed 60 square arcminutes to calibrate contamination.
- 25 pc resolution, expecting ~2000 clouds with $>10^3$ $M_\odot$

But what about problems SCUBA-2 and extended structure?

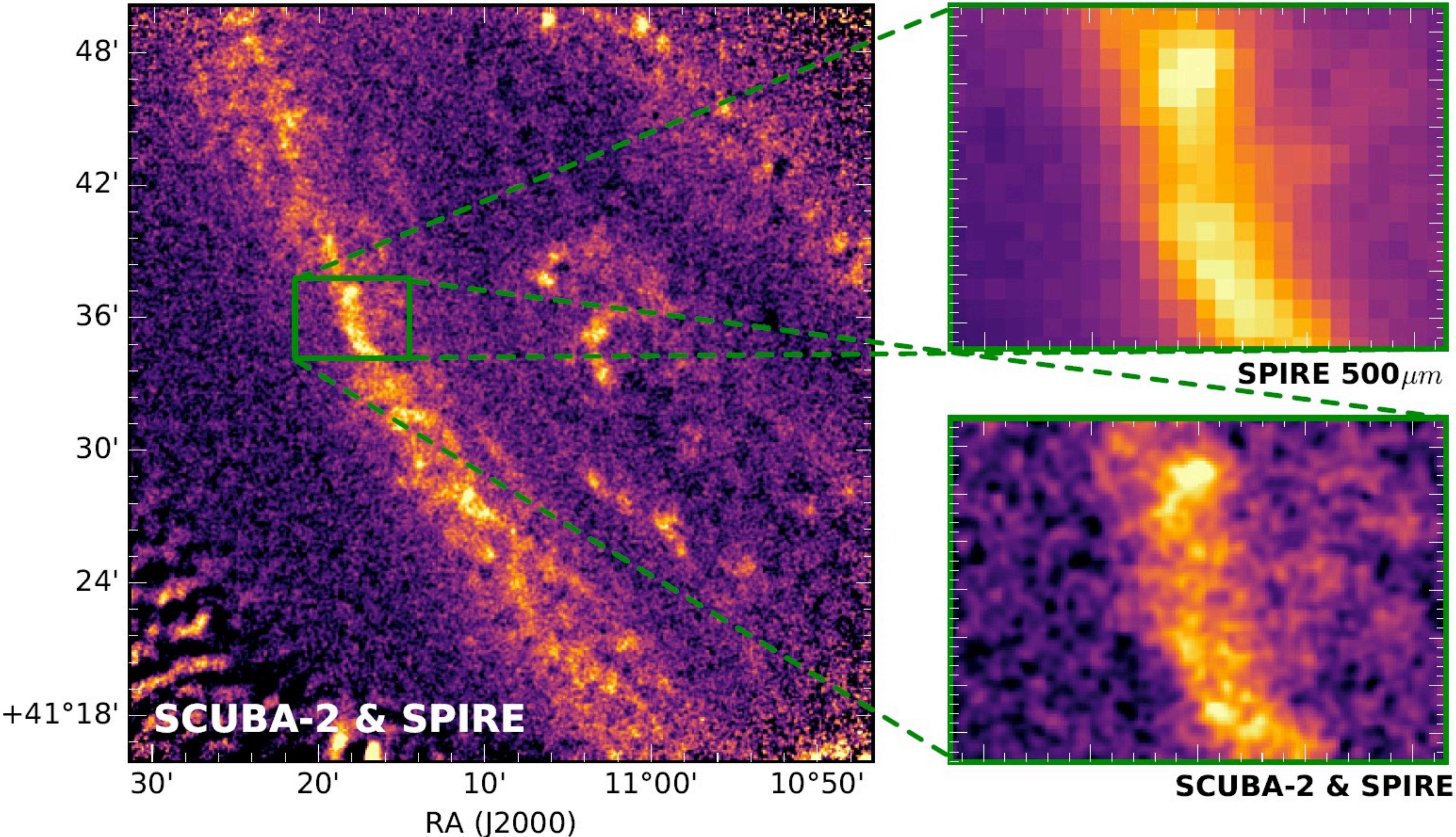
Large scale Structure

- SCUBA-2 uses filtering in the DR, set too light instrumental noise dominates, too harsh remove emission
- Use Planck 870μm to recover large scales so can use stronger filter
- Below – pilot data, only at full depth in central 30' region



450μm

- At 450μm we use the SPIRE 500μm emission to recover the large scale emission



Coordinators & Management Team

- HASHTAG Coordinators:
  - Canada: Christine Wilson
  - China: Zhiyuan Li
  - Japan: Tsutomu Takeuchi
  - South Korea: Aeree Chung
  - Taiwan: Ciska Kemper
  - UK: Matt Smith
- Management Team:
  - Observing Manager: Y. Gao
  - MSB Manager: B. Lee & A. Chung
  - SCUBA-2 Lead: M. Smith
  - PPMAP Lead: K. Marsh
  - Spectroscopy Lead: Z. Li
  - Ancillary Data Manager: O. Morata
  - Outreach: Team (incl. R. De Grijs and H. Gomez)

Observing Status

- Total 35 % Complete
- 100% Band 3 CO Completion (55 hr)
- 19% Band 2 completion (~41 hr)
- Had bad luck during our observing runs, most of our data was from other days.
- The vast majority of science relies on the SCUBA-2 data, so early

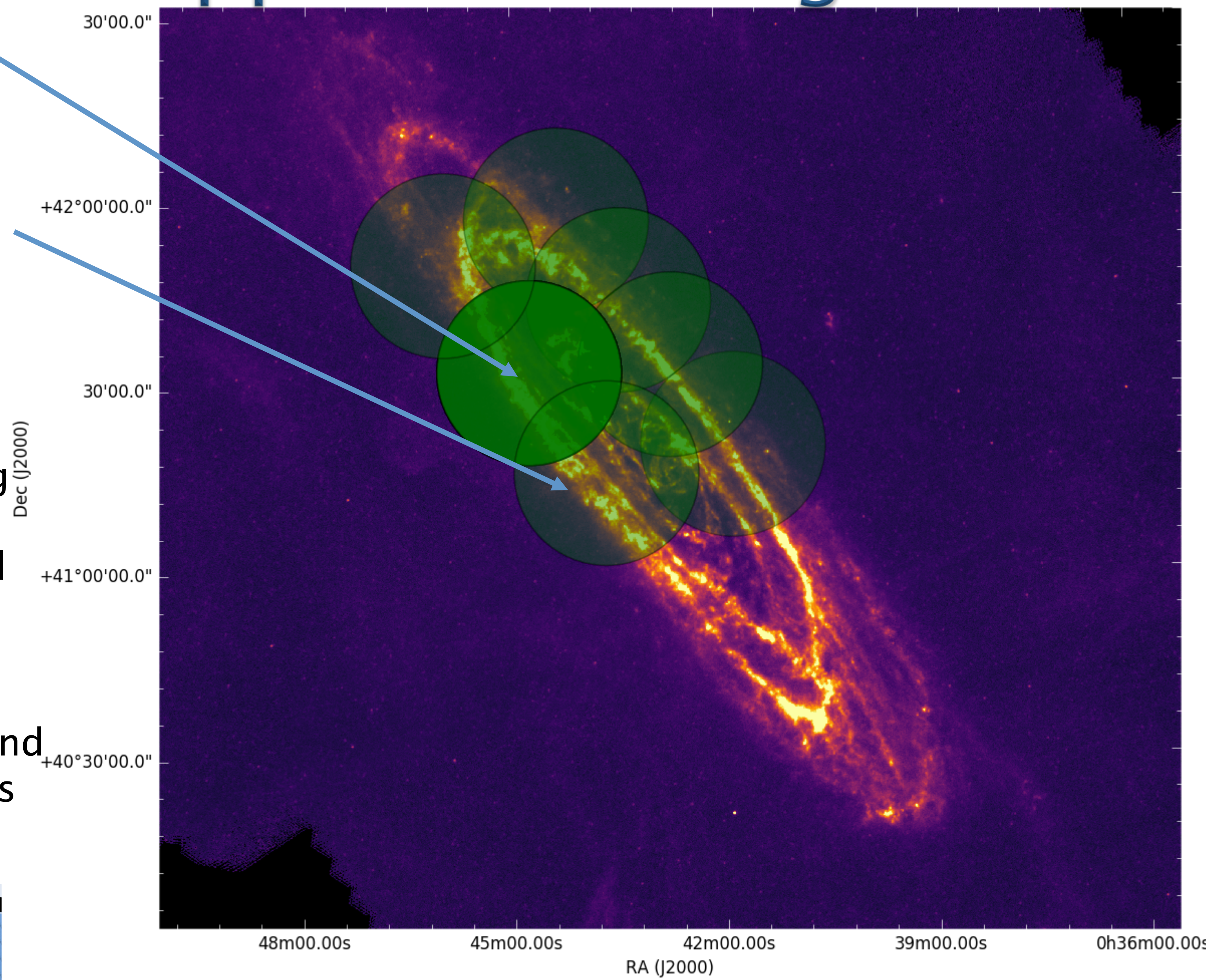
SCUBA-2 Approach + Progress

Full depth pilot data

Plan to observe each pointing initially to half depth – this is to allow search for transients.

All points have two overlapping pongs so at the end only ¼ final observations

Will continue across centre and then finish ends



A few notes on SCUBA-2 processing…

- We download and roughly process observations as they are taken (all data has been verified)
- Skyloop:
  - Good News: The 2016/7 skyloop bug found by JINGLE causing masking of good data has been fixed in latest Starlink.
  - Bad(ish) News: Test with HASHTAG show my modified skyloop script is just over twice as fast as pipeline version, and copes better with memory. Recently made some changes to make stable and will feed back script to observatory.
- The full final SCUBA-2 map will be a challenge but appears achievable with current machines.

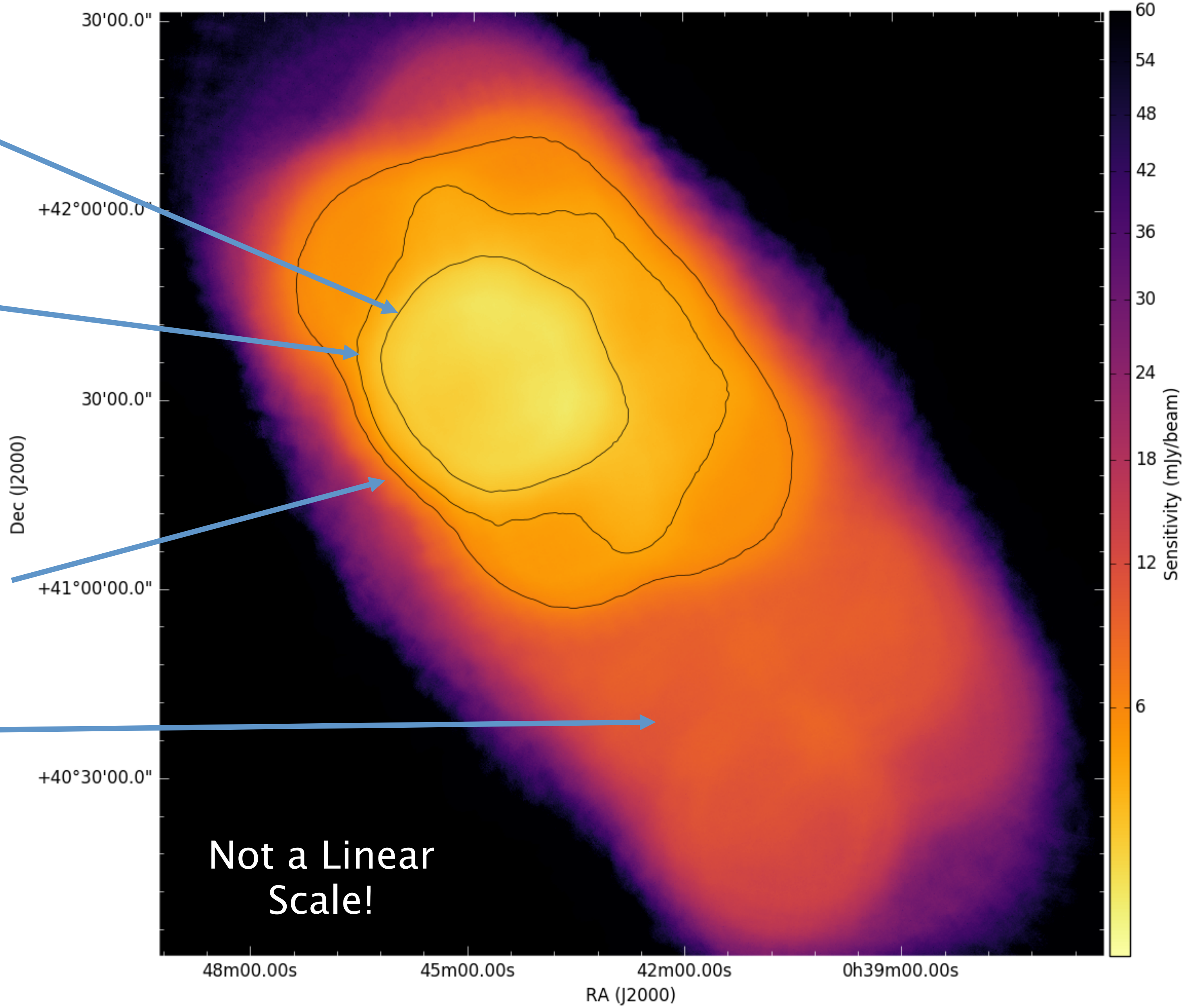
SCUBA-2 Current Status

3.0 mJy/beam (Full Depth)

4.24 mJy/beam (Half Depth)

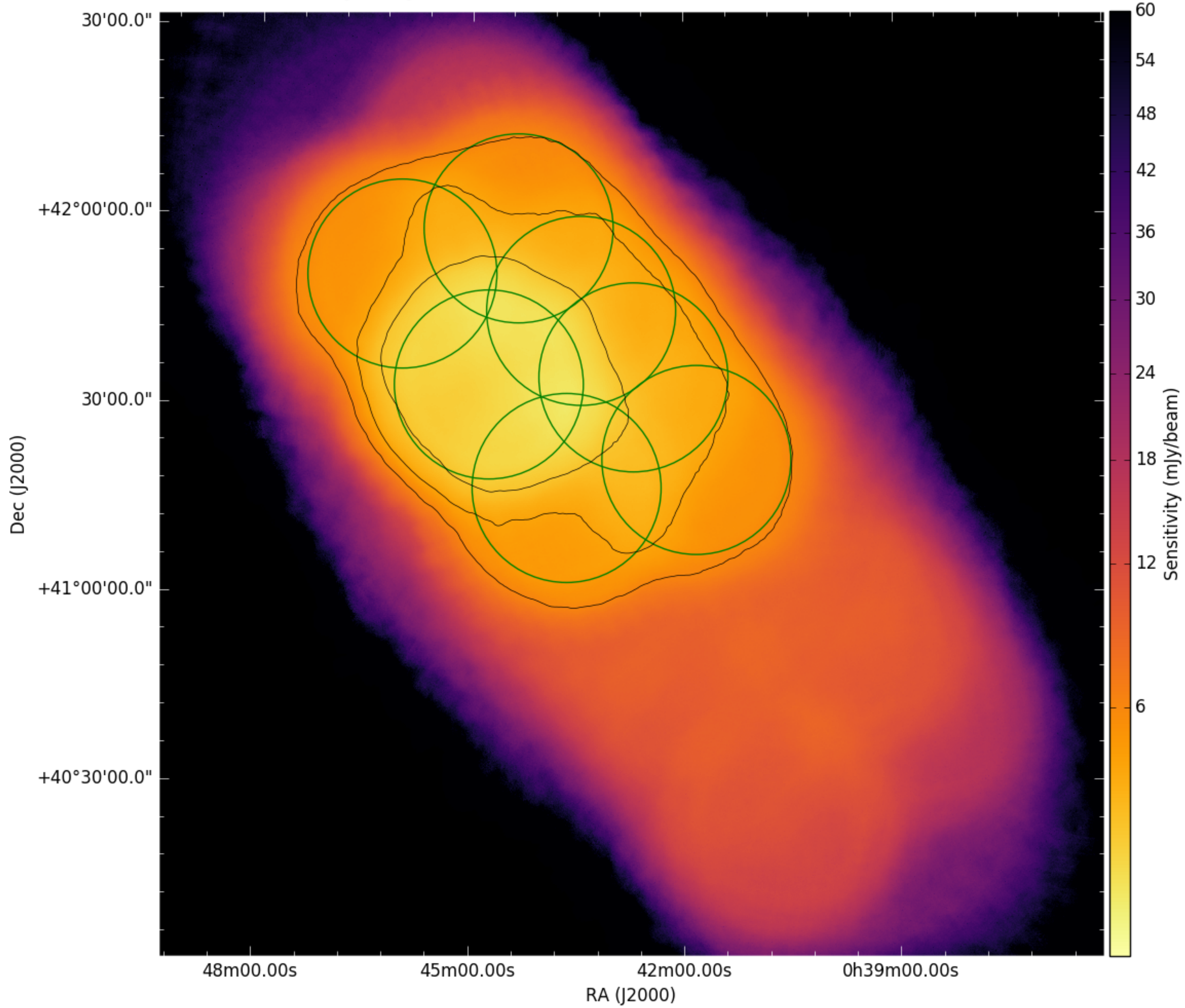
6.0 mJy/beam (Quarter Depth)

Old very shallow M31 survey



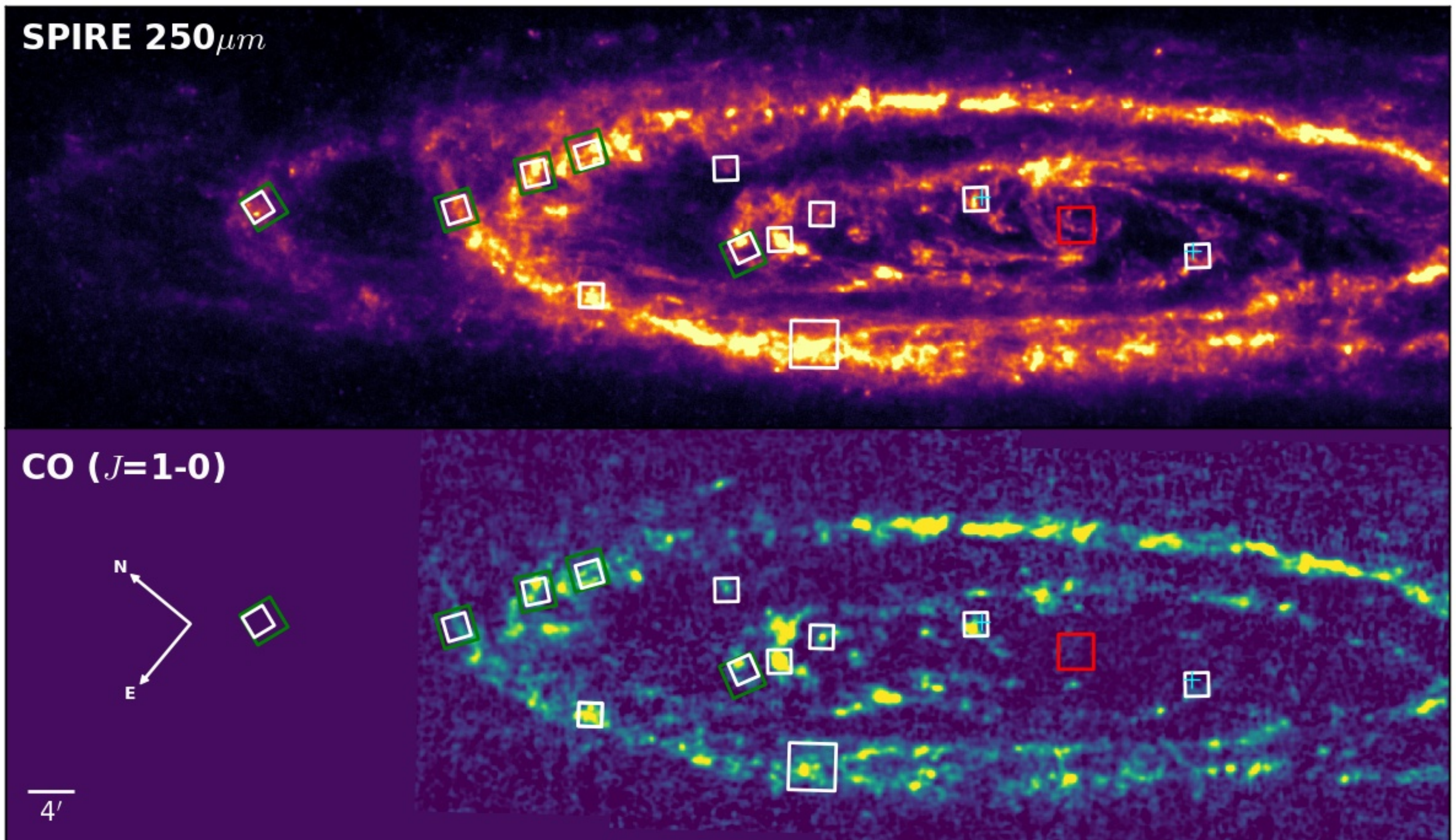
Current Status (3)

Based on current observations we're bang-on the sensitivity target



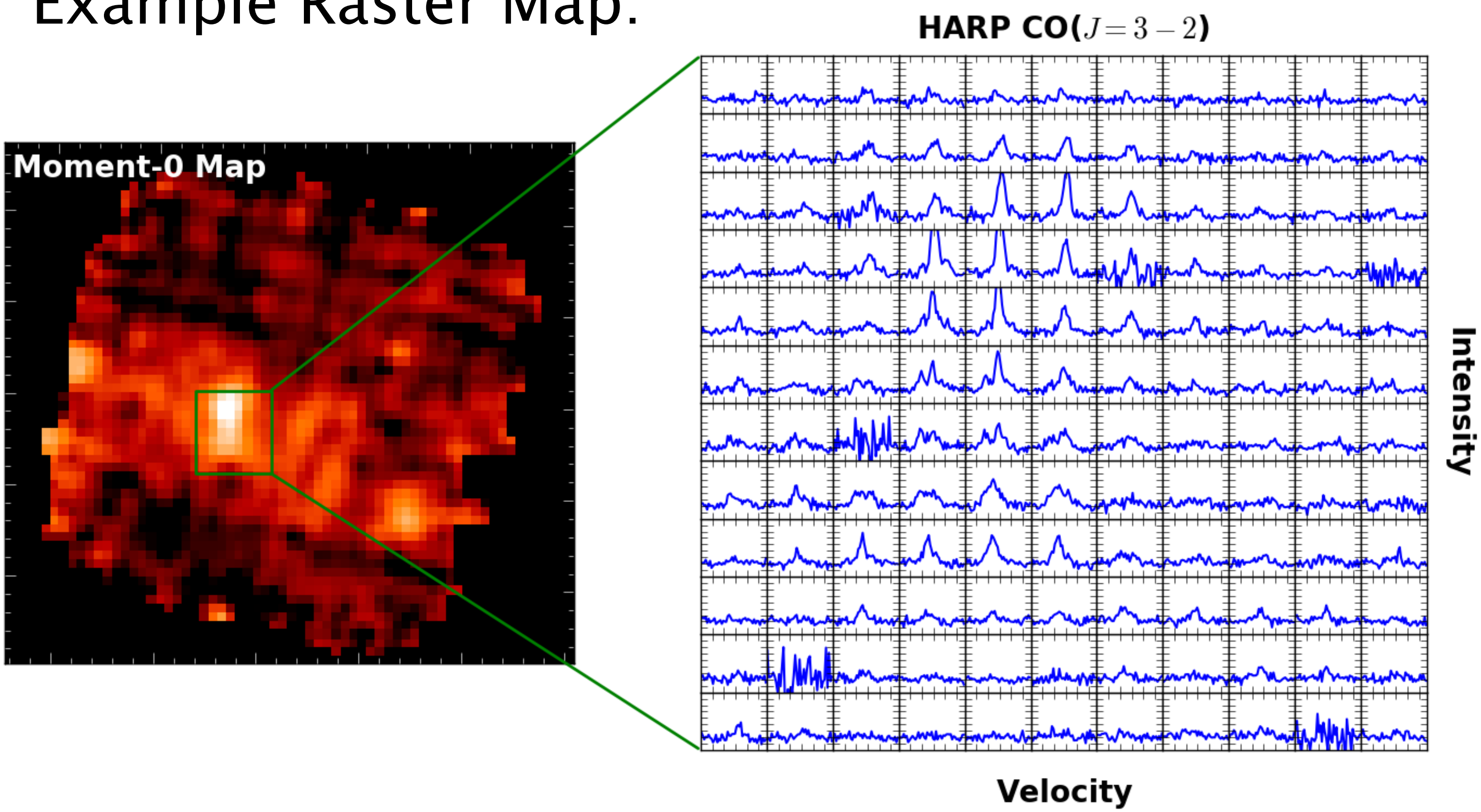
HARP CO Program Status

- All data taken! (11 2'×2' JIGGLEs & 1 4'×4' raster)
- We've reduced all the fields using standard pipelines
- Currently working on new data products



Example Data

- Still work in progress
- Example Raster Map:



Initial Papers (planned for 2018)

- Paper 1:
  - Survey overview paper
  - Will include simulations on optimum way to reduce the data (these currently running, injecting simulated M31 into Lockman-Hole CLS Field)
  - Initial analysis of pilot data (e.g., β-relations etc…)

- Paper 2:
  - The CO data processing description
  - Analysis of best way to subtract CO(J=3–2) line from SCUBA-2 maps
  - Comparison with other CO tracers

HASHTAG – some science goals

- Properties of dust and what do they depend on
- Testing the origins of β–T relation
- What is heating the dust?
- Measure variations in gas-to-dust and X-factor
- Investigate the origins of the KS-law
- SF in M51 found to be in spurs off the spirals arms. In M31 we can test morphological relationship between SF & ISM, by using OB stars in PHAT and other star-formation indicators
- Sub-millimetre transients

Marsh et al. (2015)

SED Fitting – PPMAP

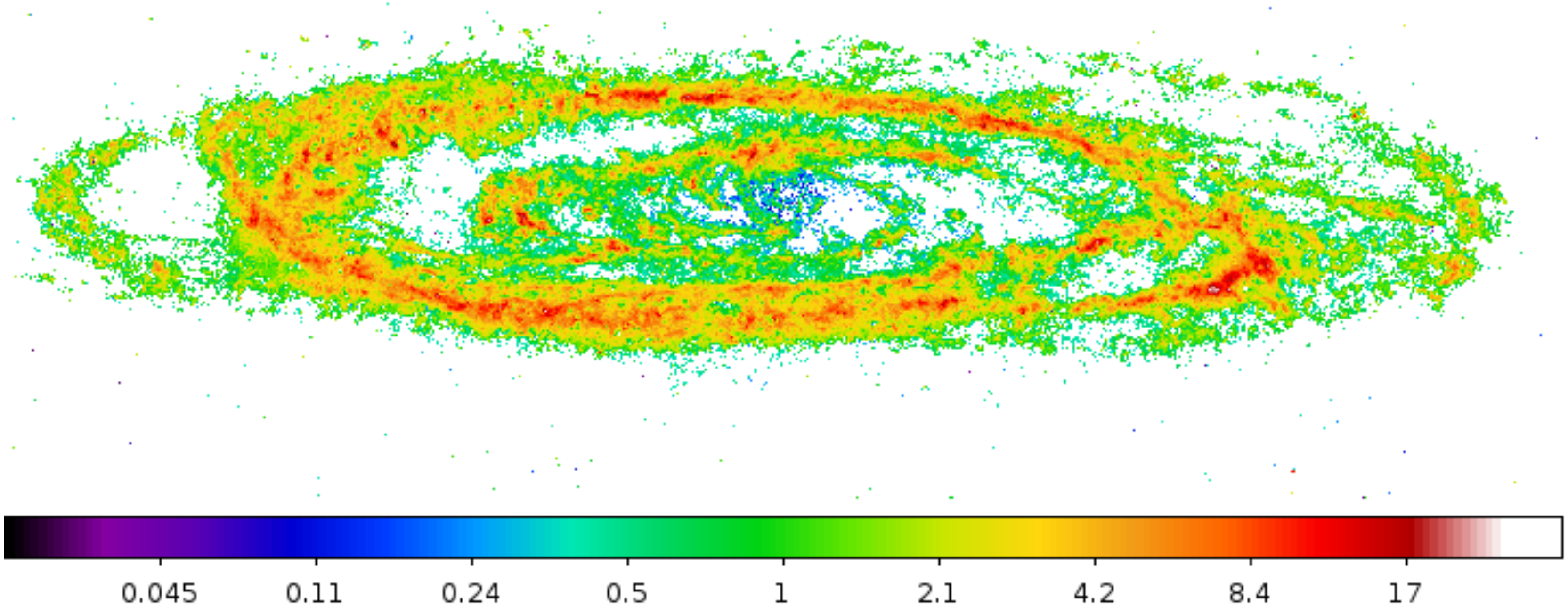
- Standard SED fitting techniques often are not optimal as requires:
  - Smoothing all data to a common resolution
  - Normally make an assumption, either one or two temperatures, or a certain distribution of temperatures (from ISRF)
- With M31 we have a very extended high signal-to-noise object which means we can use more advanced models

Marsh et al. (2015)

SED– fitting PPMAP (2)

- PPMAP is unique as instead of assuming a power law–distribution, as we use the data to find the mass of dust for a combination of T and β values (usually logarithmically spaced).
- One Assumption – all has to be optically thin.
- The next few slides shows an early test when applied to just *Herschel* data. Adding in HASHTAG will greatly increase our sensitivity and resolution to cold temperatures/ emissivity index

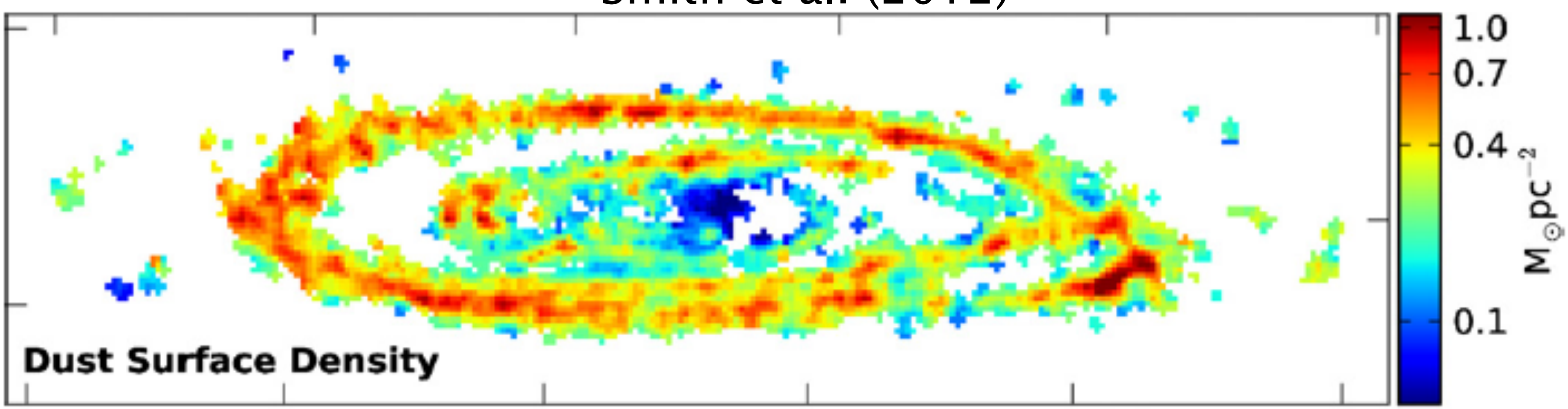
Total line-of-sight column density



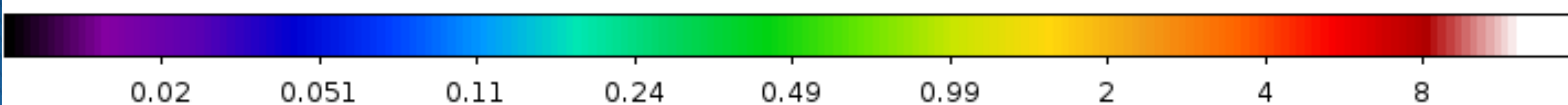
PPMAP

Standard Method

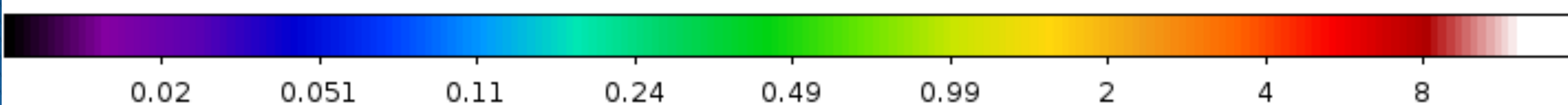
Smith et al. (2012)



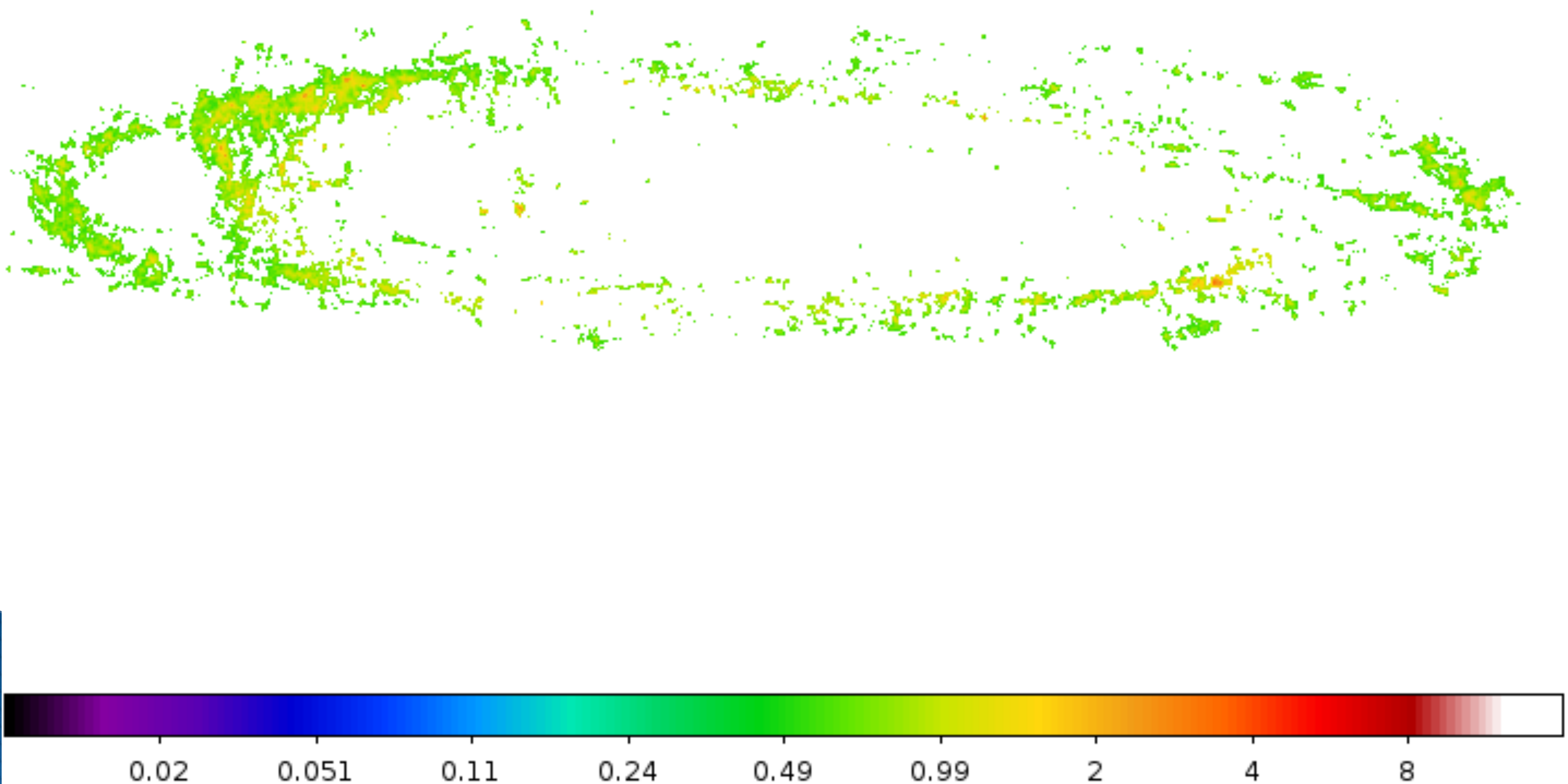
T = 10.0 K



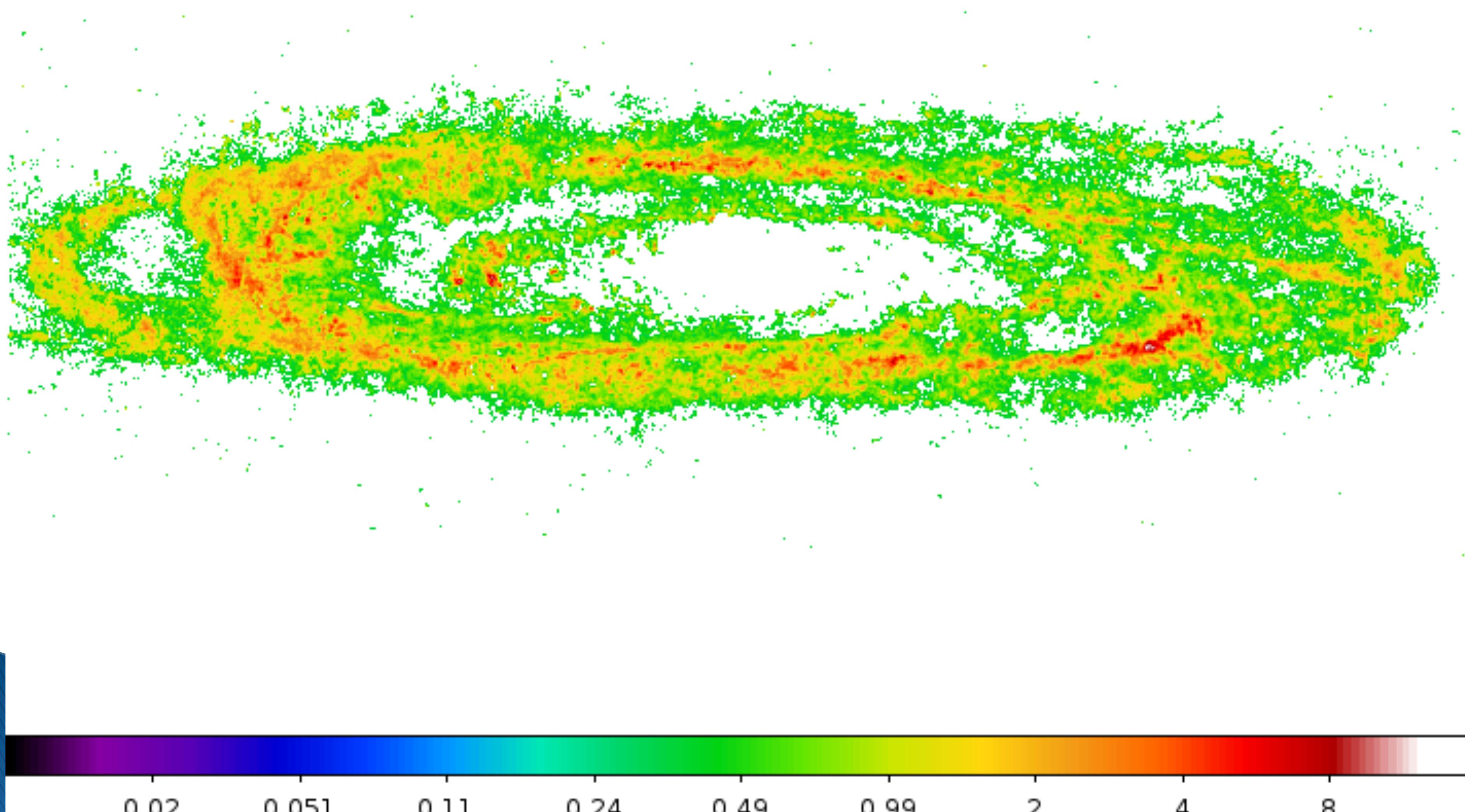
T = 11.6 K



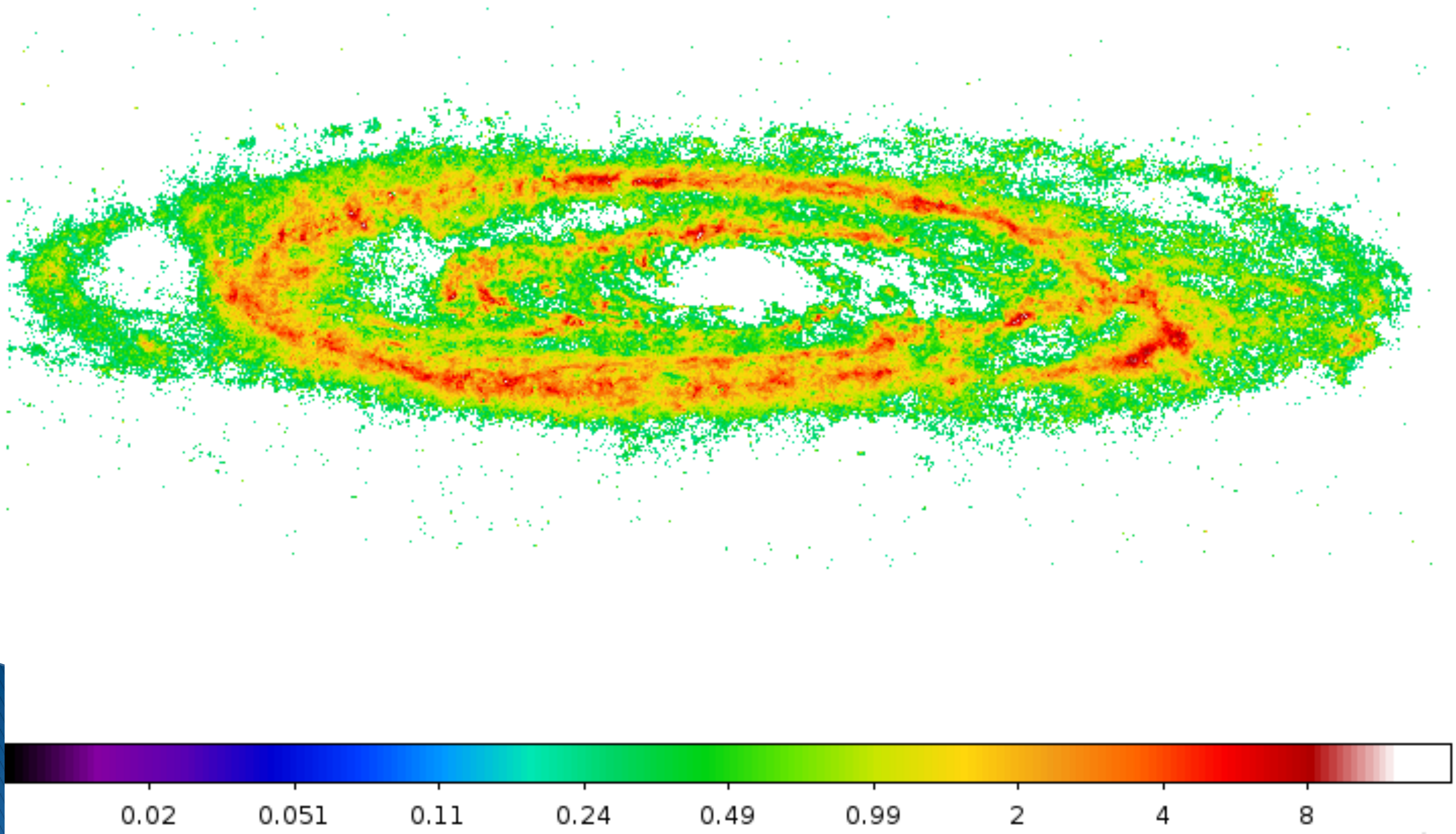
T = 13.4 K



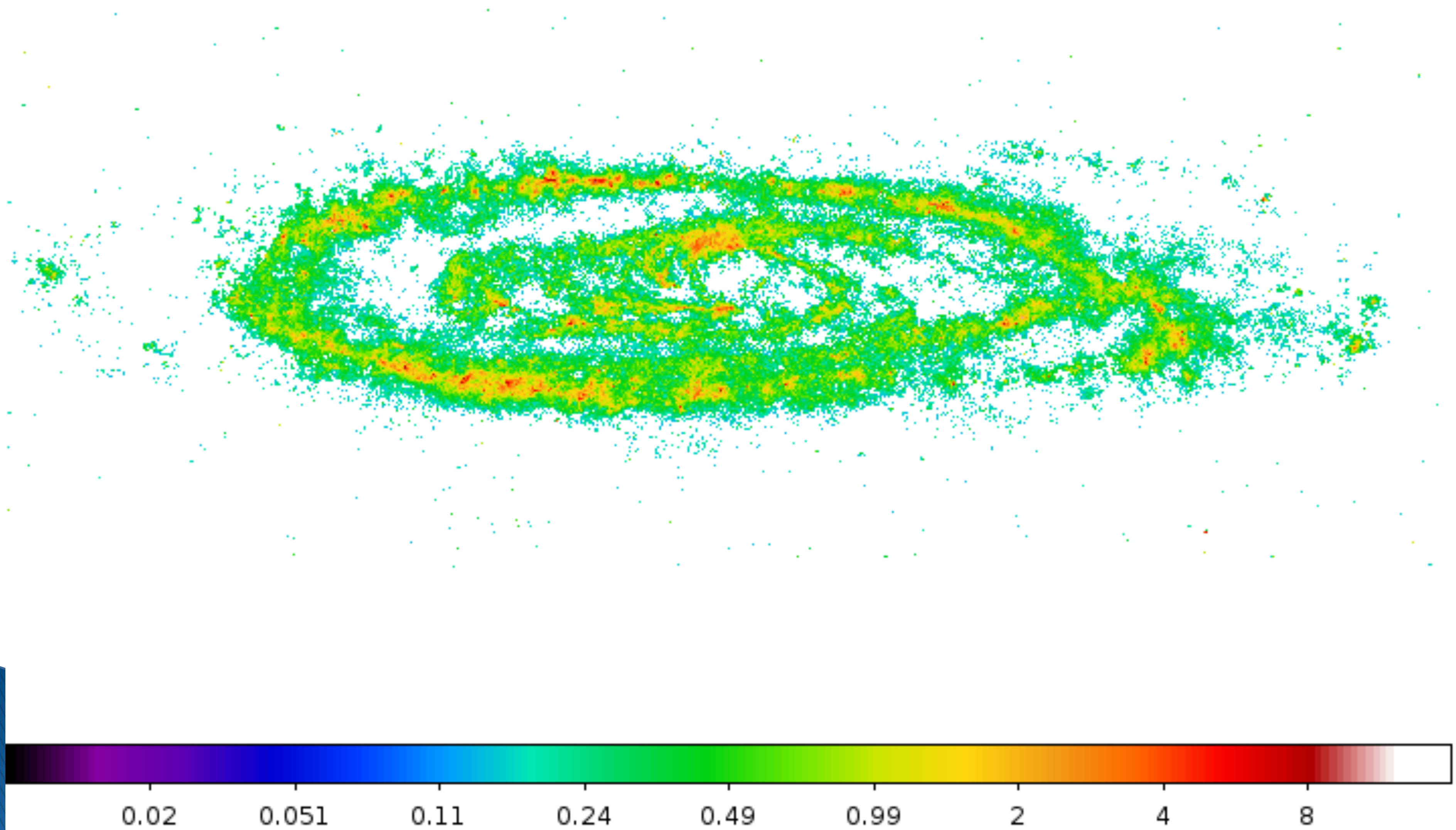
T = 15.5 K



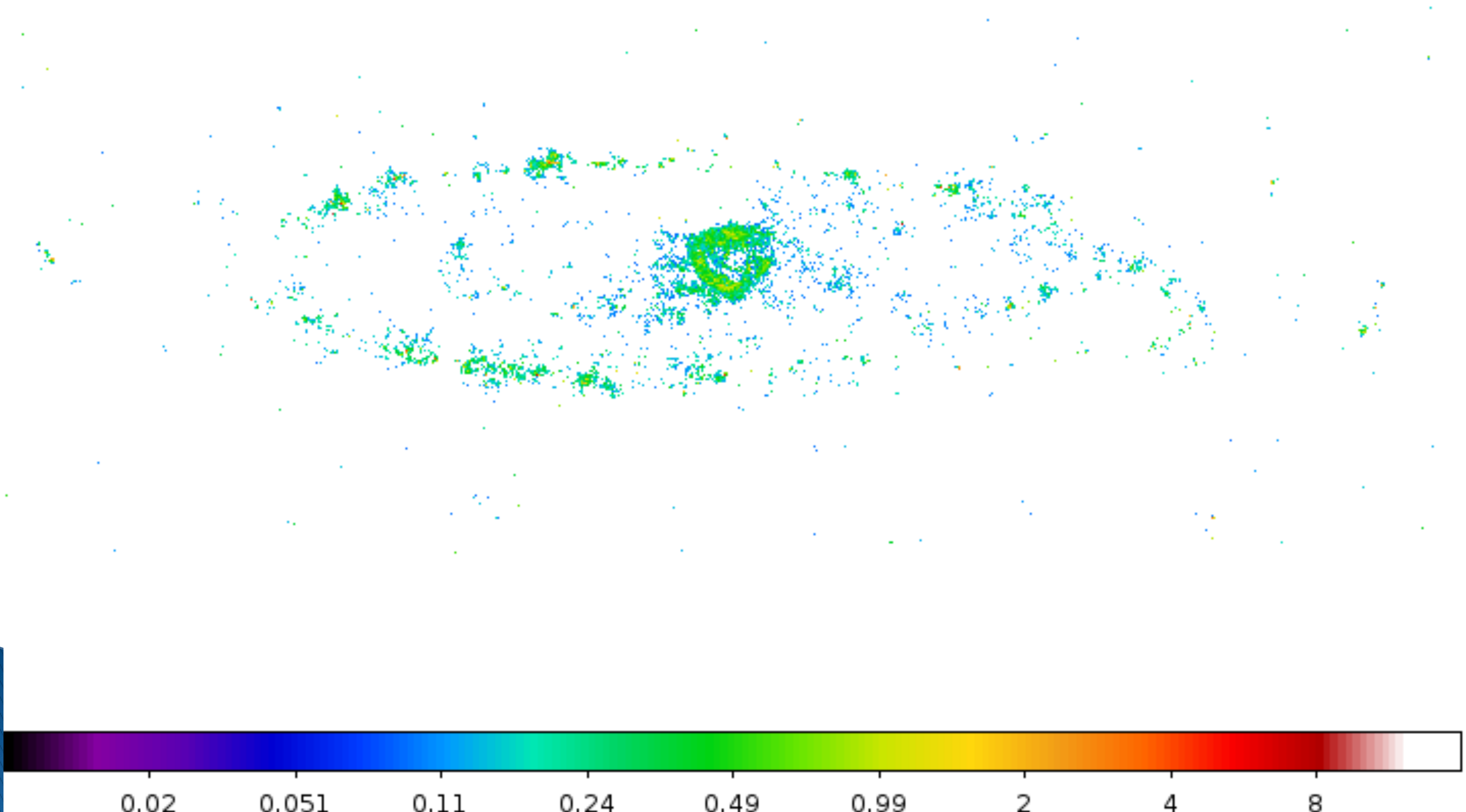
T = 18.0 K



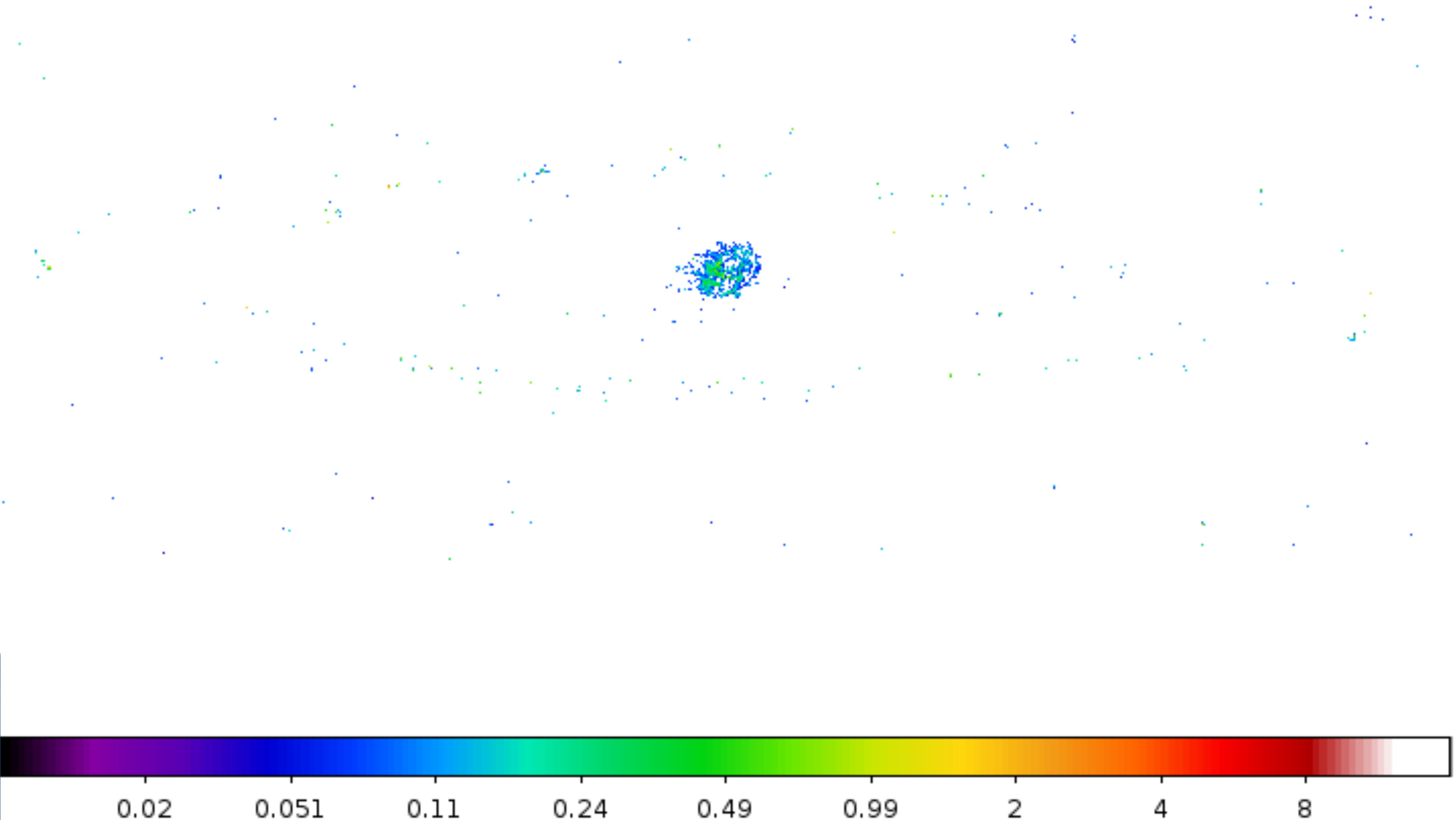
T = 20.8 K



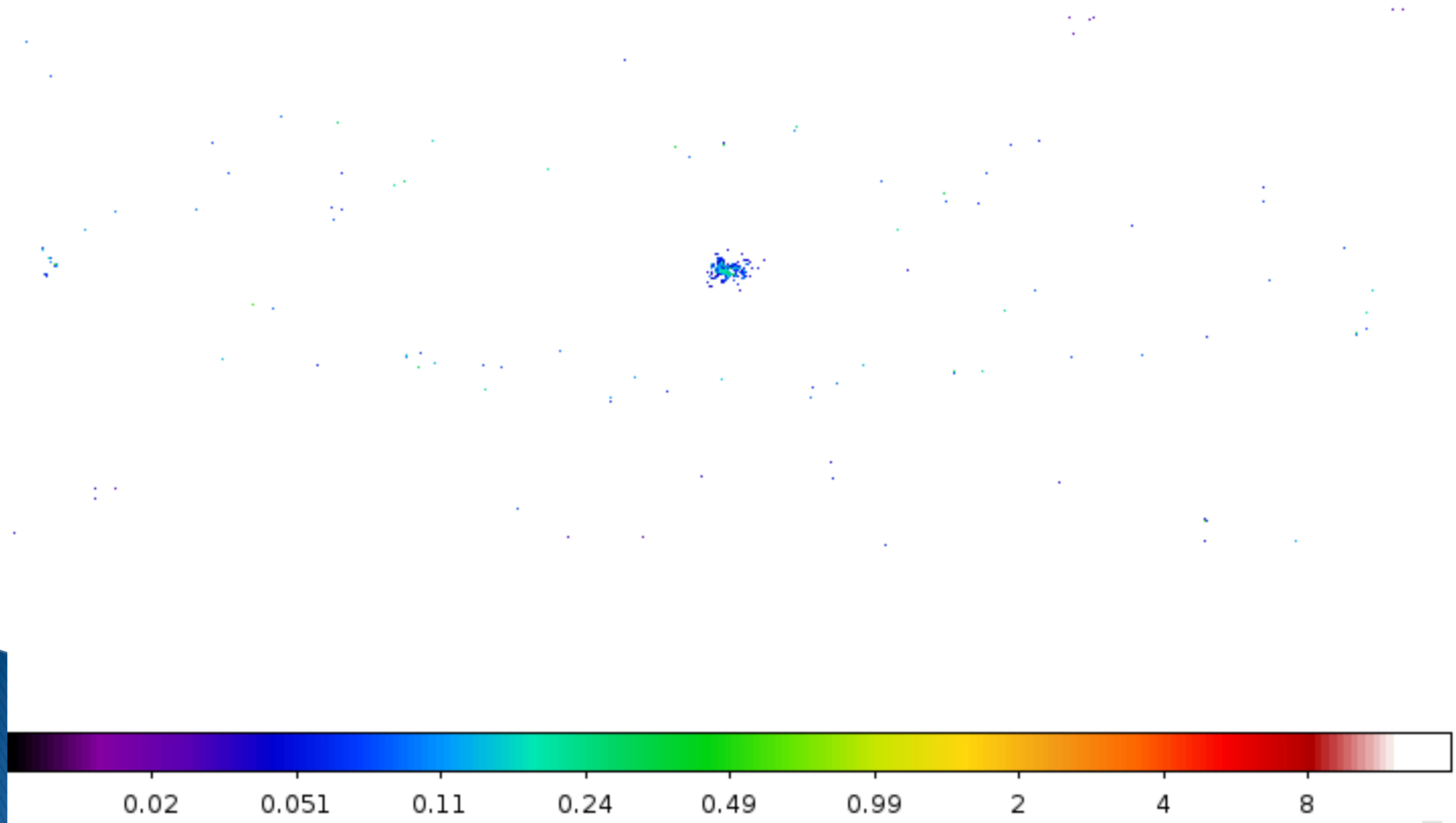
T = 24.1 K



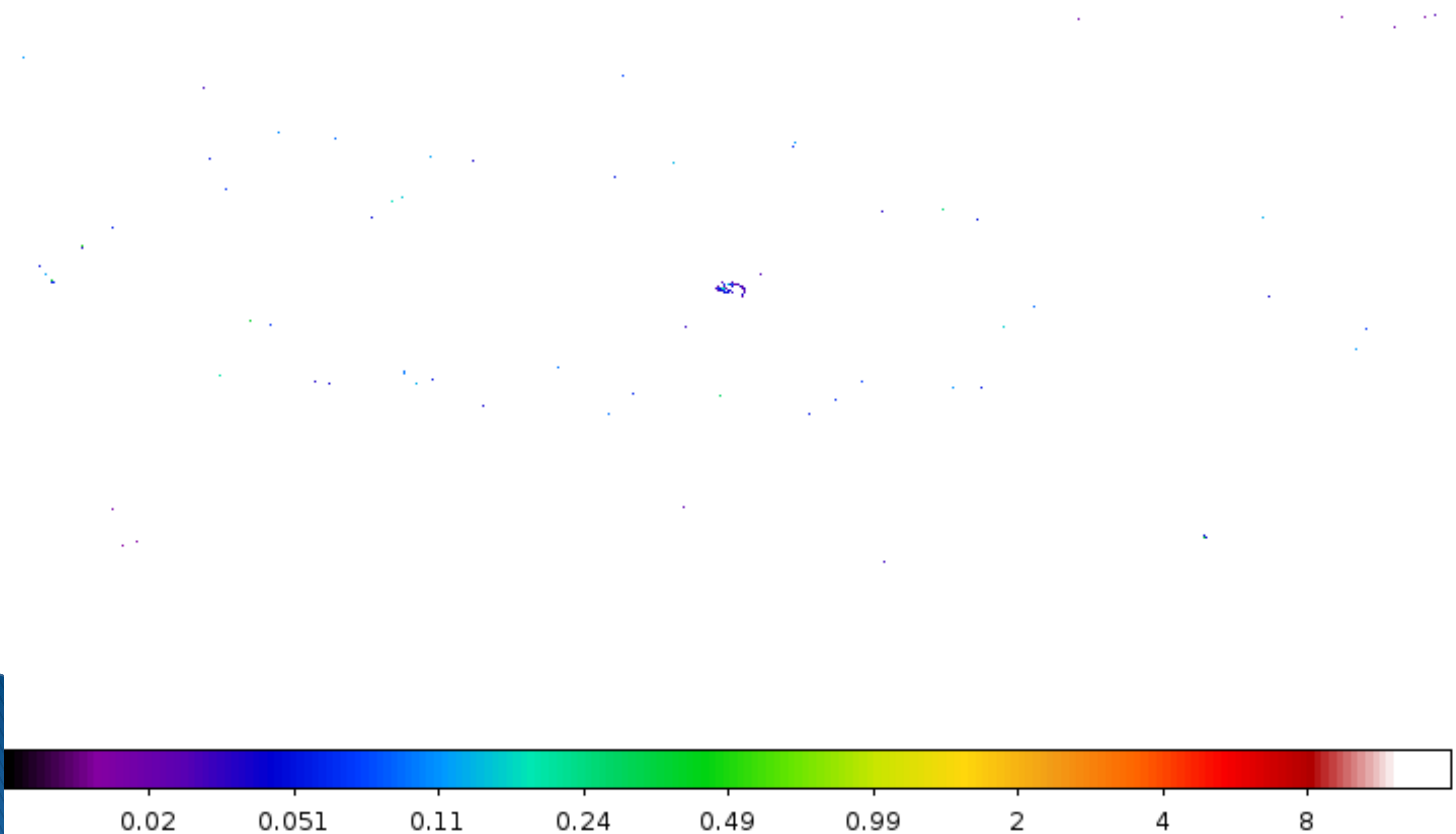
T = 27.8 K



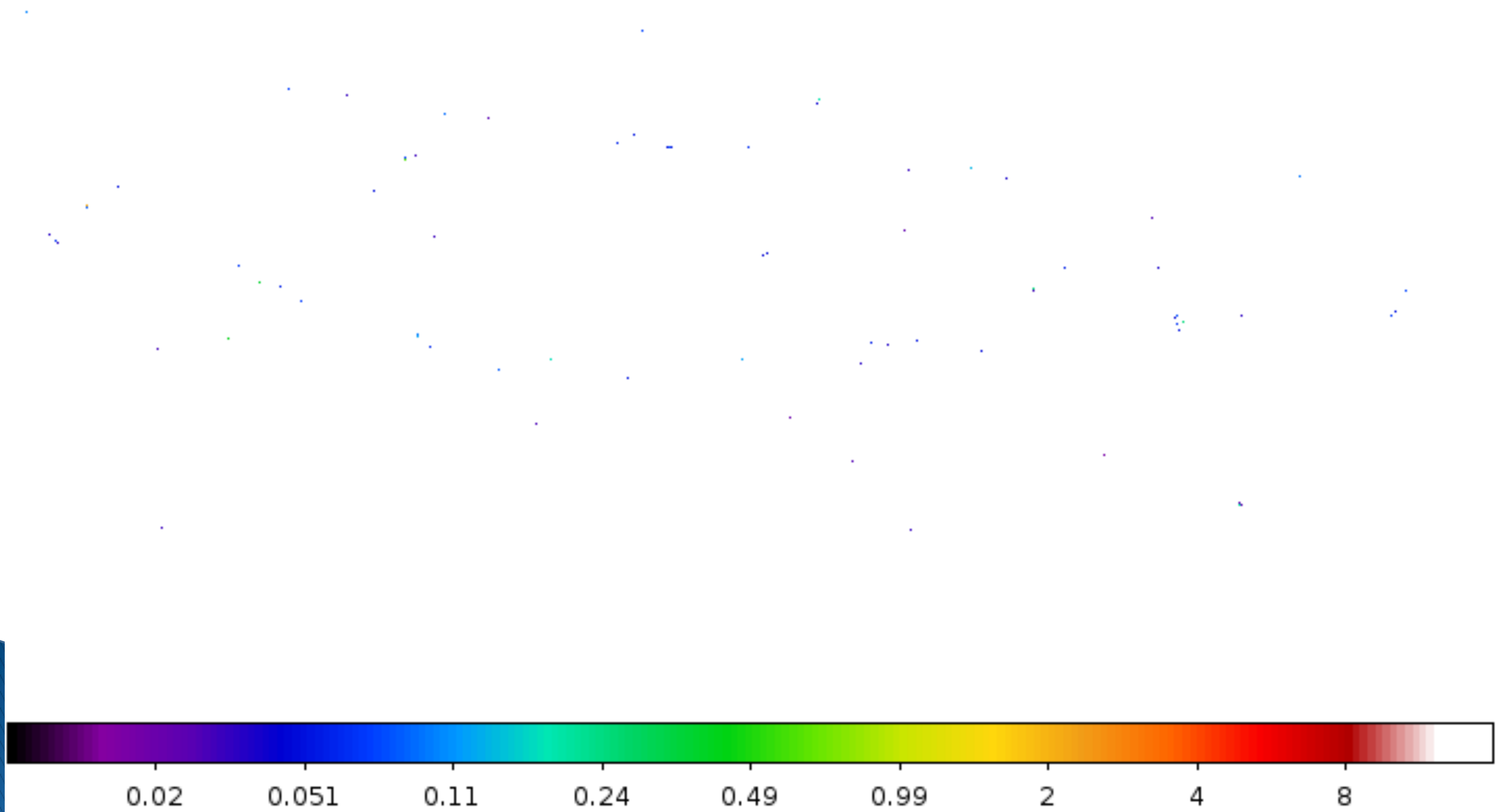
T = 32.2 K



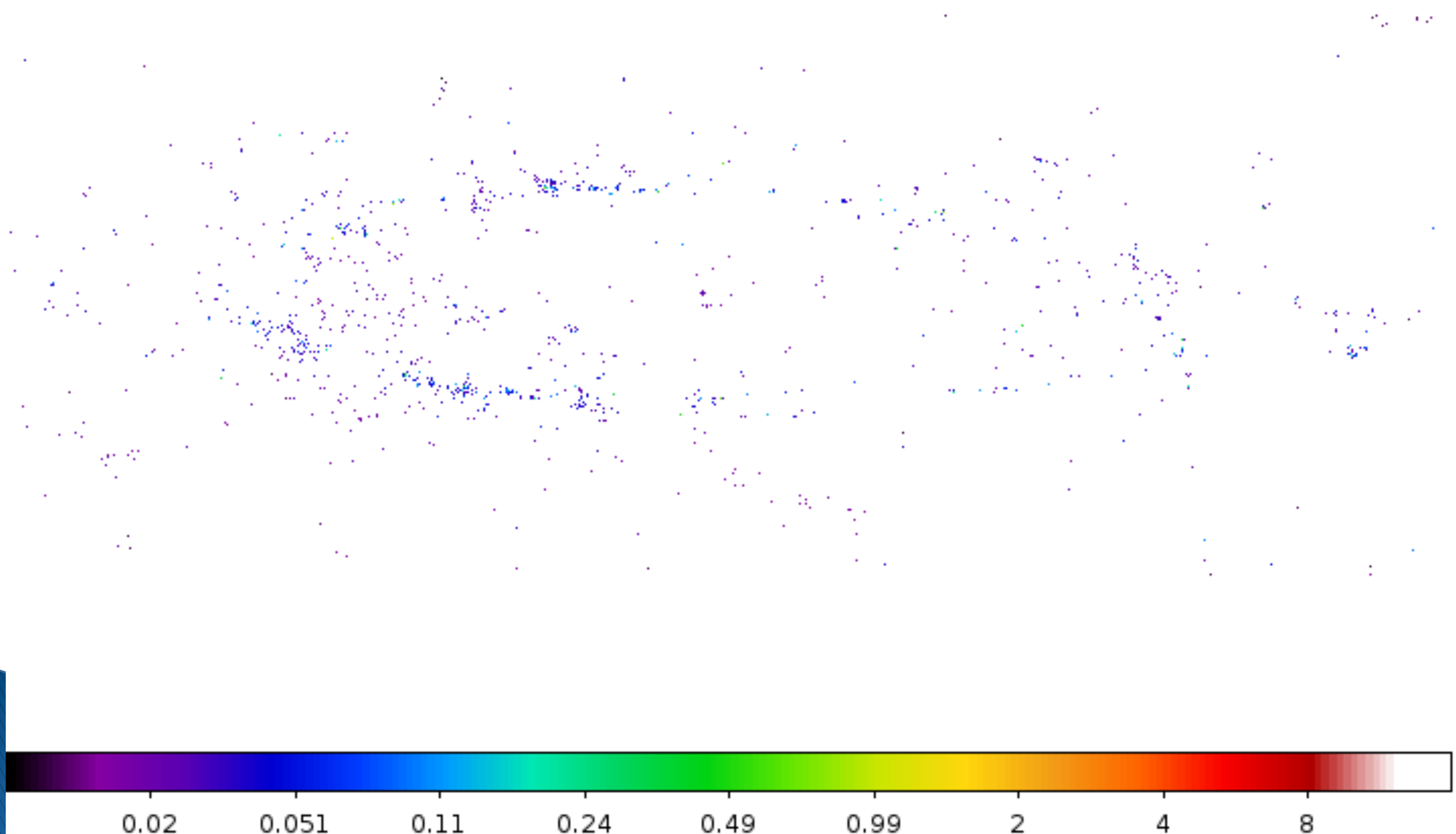
T = 37.3 K



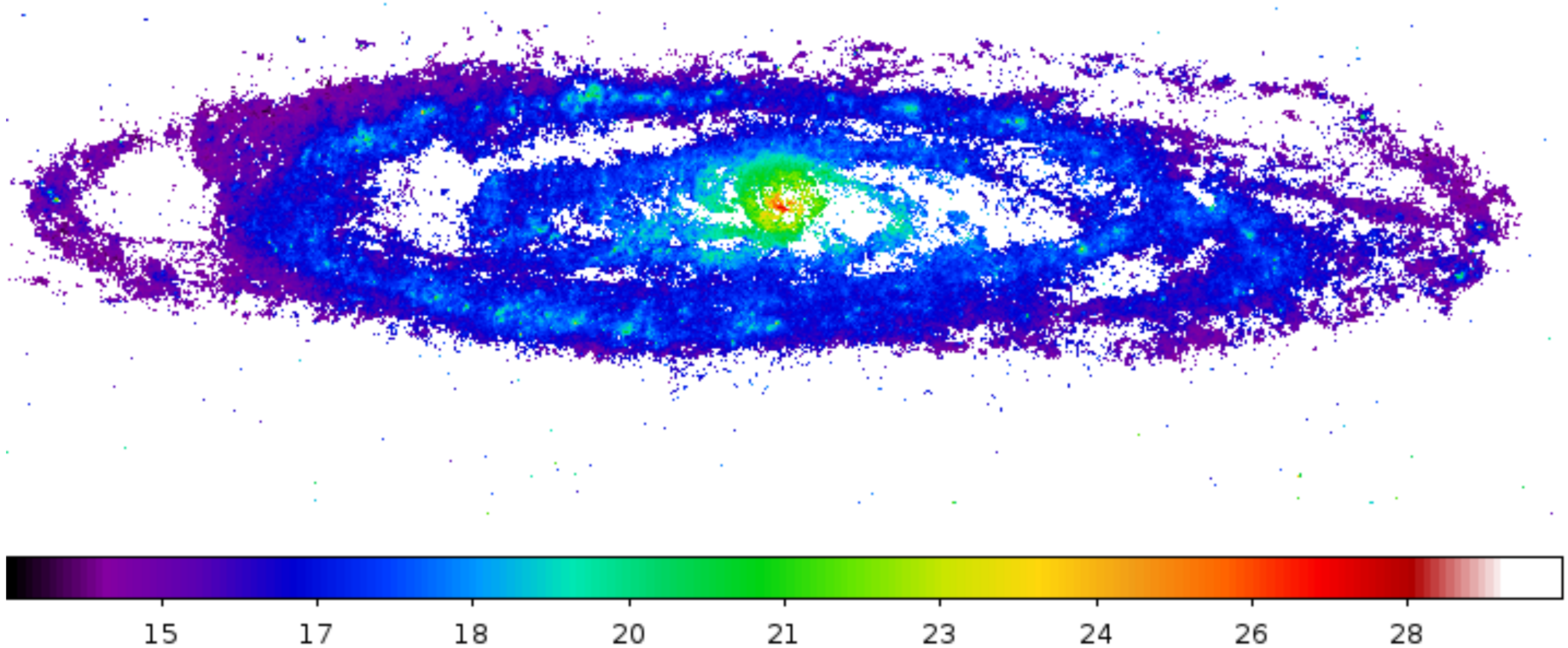
T = 43.2 K



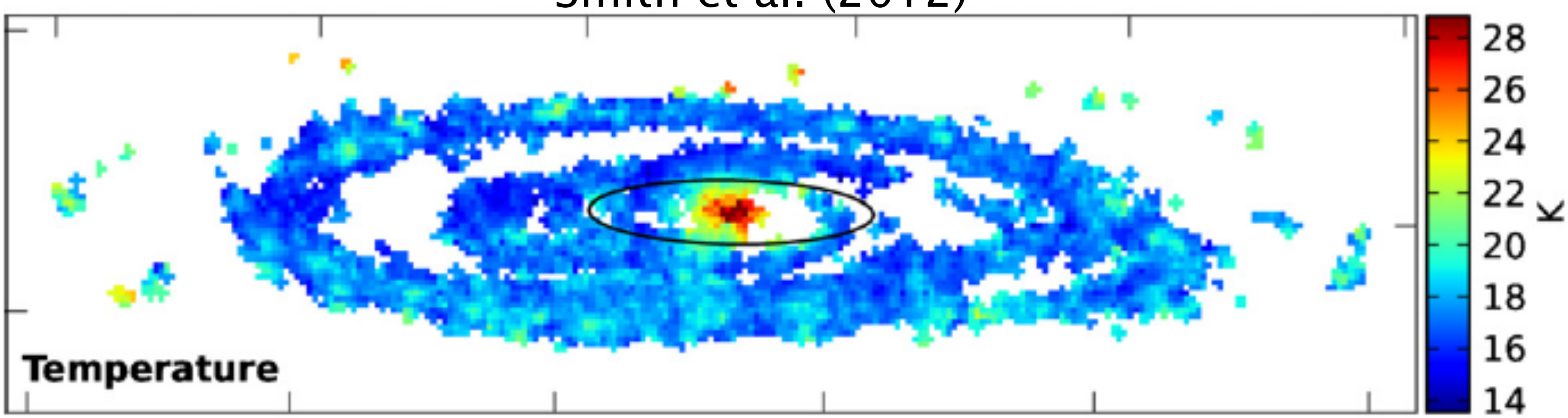
T = 50.0 K



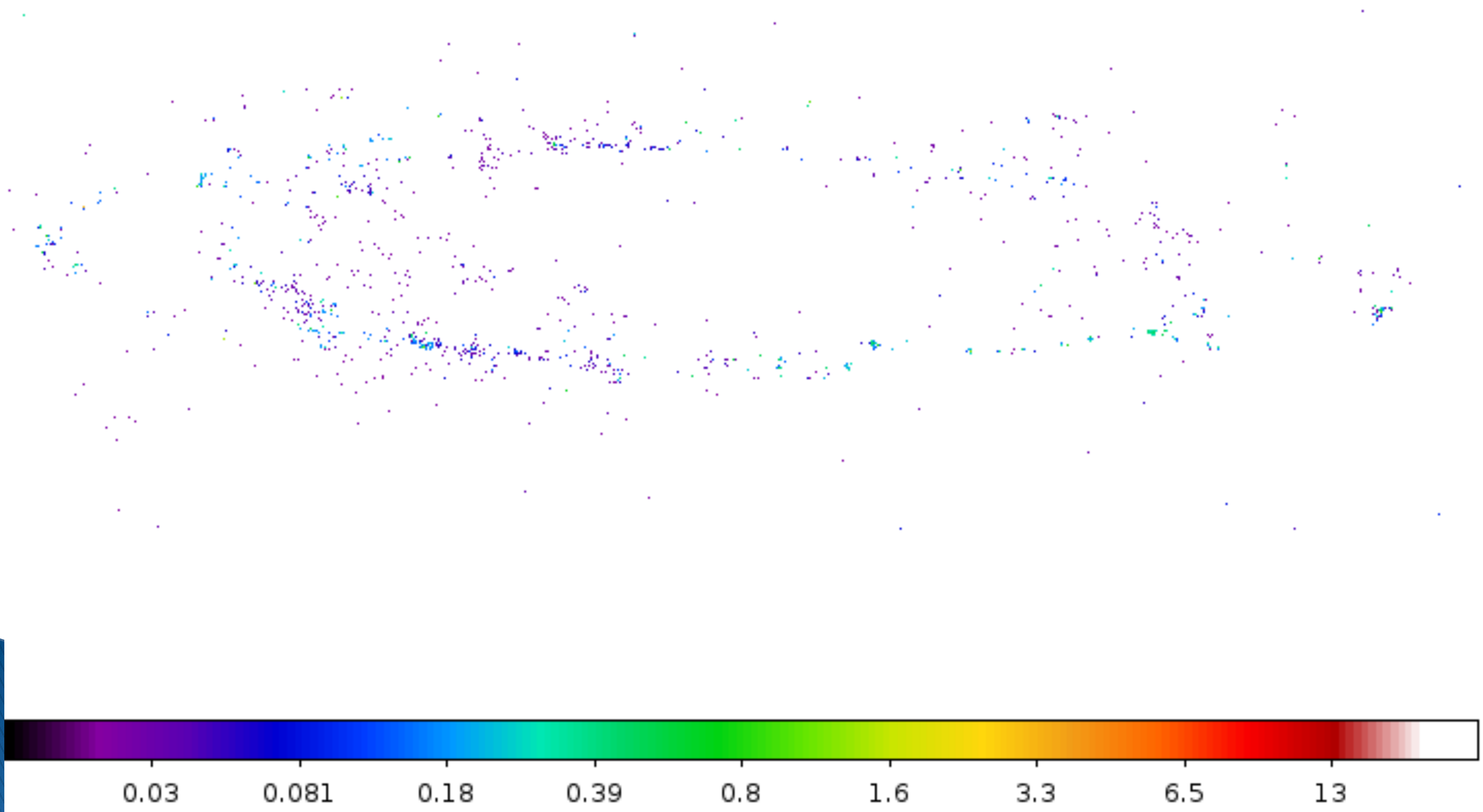
Mean line-of-sight temperature



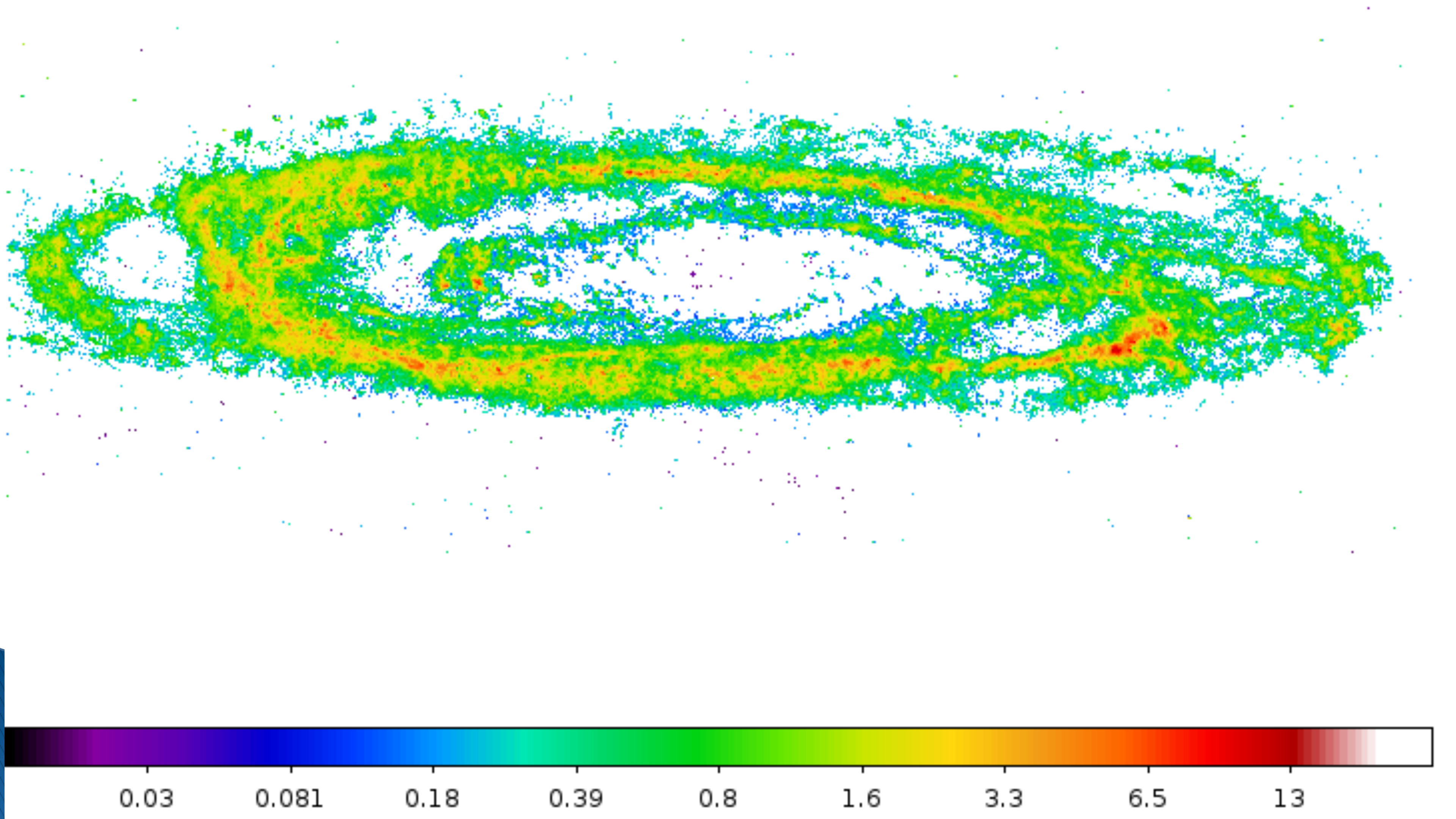
Smith et al. (2012)



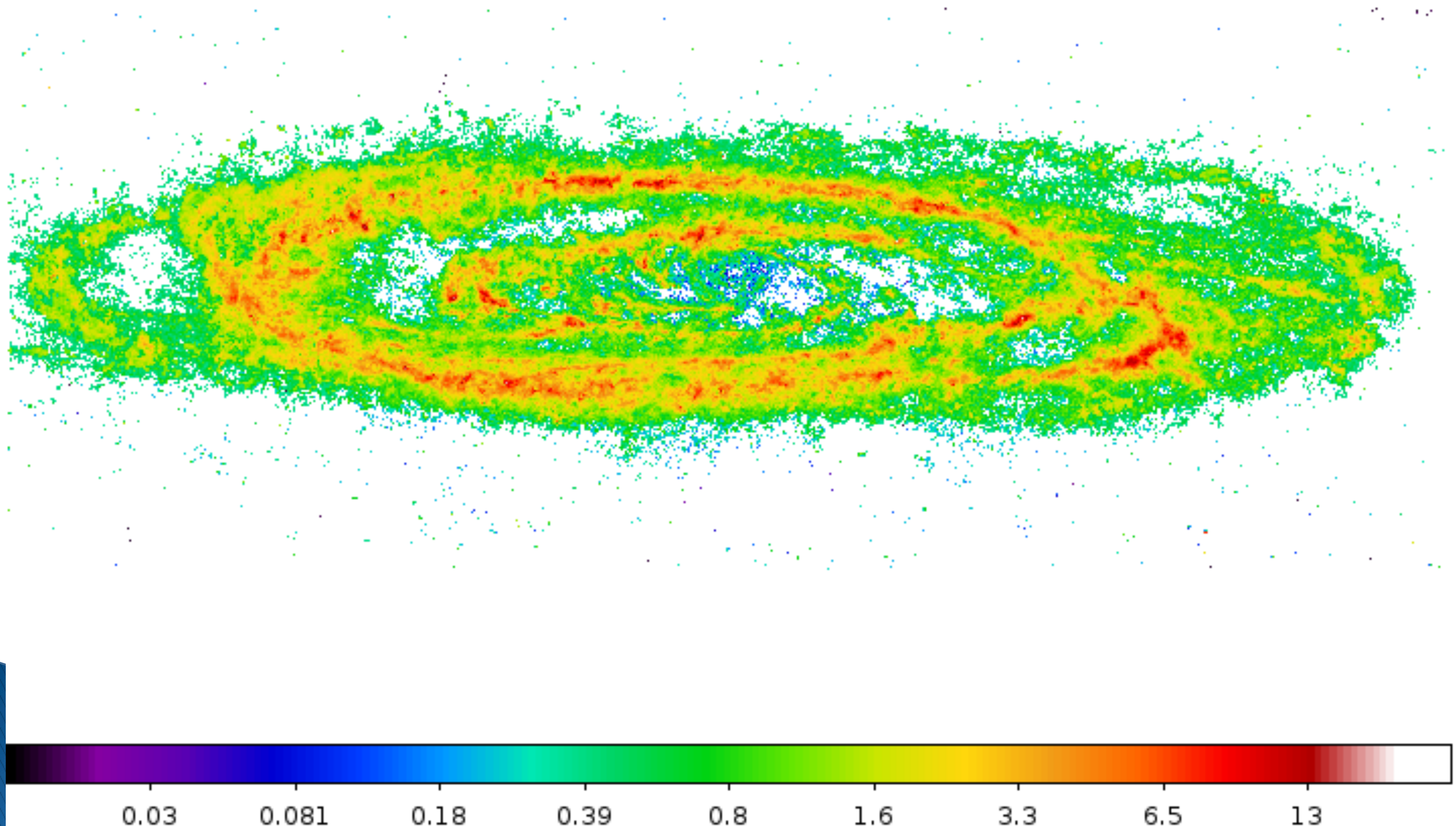
$\beta = 1.0$



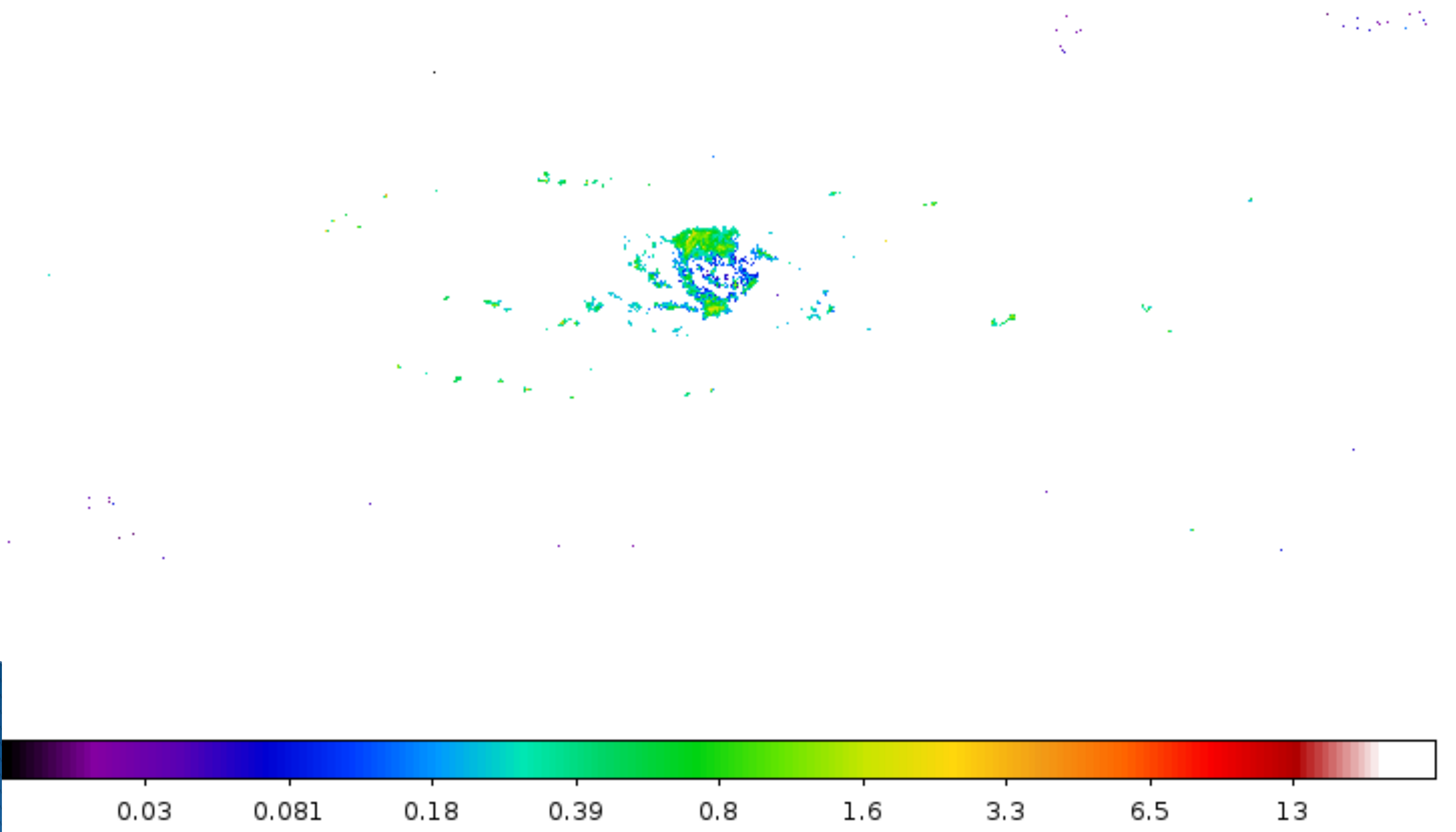
$\beta = 1.5$



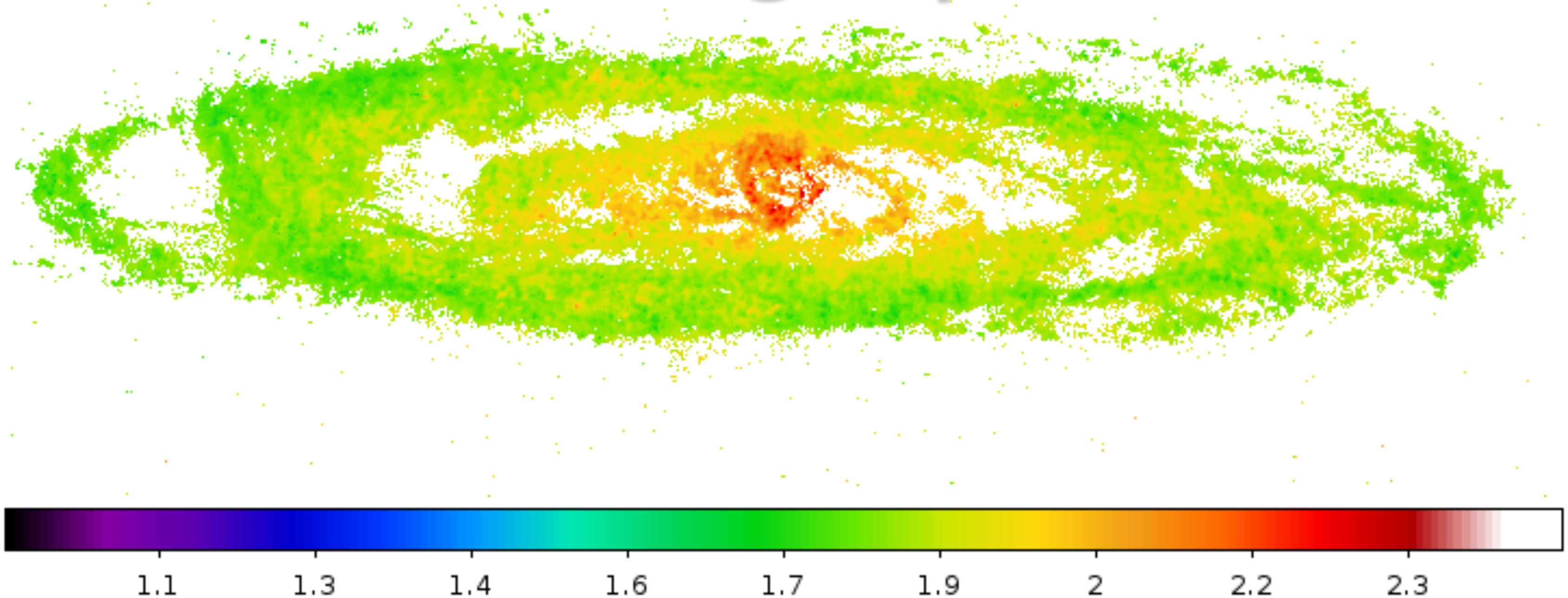
$\beta = 2.0$



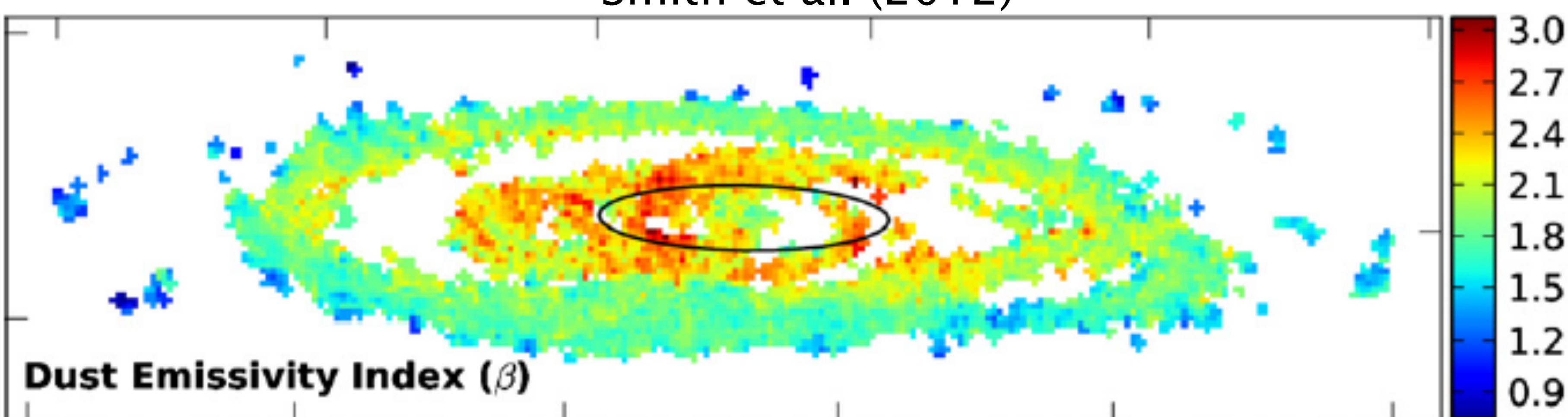
$\beta = 2.5$



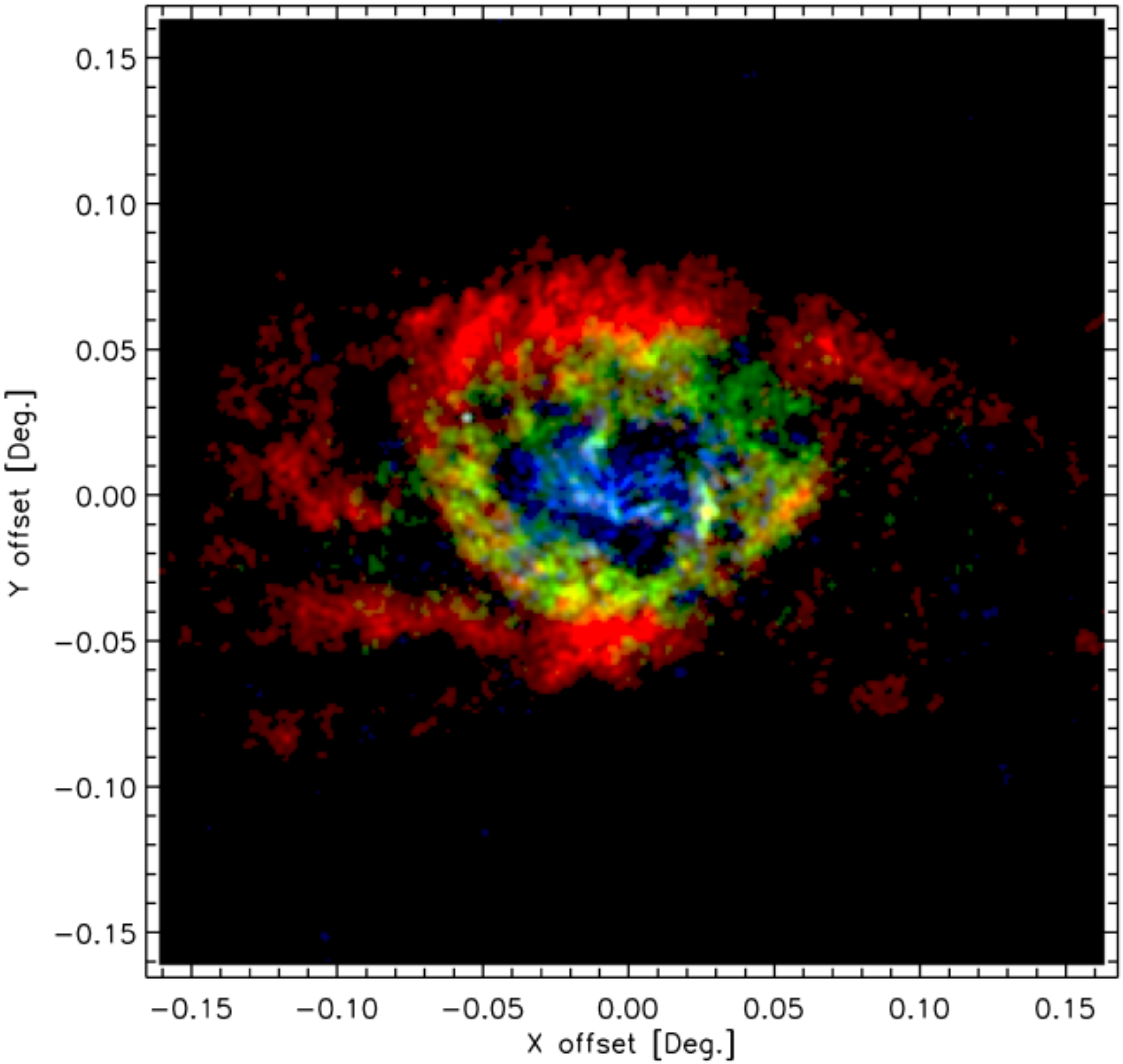
Mean line-of-sight β



Smith et al. (2012)



Nuclear spiral region: Superposition of differential column density maps at 3 different temperatures



RED: $T = 20.8$ K

GREEN: $T = 24.1$ K

BLUE: $T = 32.2$ K

Field of view:
4.4 kpc square

Still taking entries for our logo competition

#ASHTAG

JCMT Andromeda Galaxy Survey

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TAG